THE IRON AGE

New York, January 4, 1917

ESTABLISHED 1855 VOL. 99: No. 1

World-Wide Demand for American Steel

Every Country but the Teutonic Nations a Buyer of American Steel Products in 1916—Greatest Year for American Trade

GENERAL REVIEW OF THE COURSE OF BUSINESS IN 1916

REGRETTING, as we do fervently, that the chief stimulating influence was the most frightful war that ever disgraced civilization, the past year was by long odds the most prosperous the American steel trade has ever known. From start to finish, manufacturing establishments were driven to the very limit of their capacity, which can hardly be said of any previous year. The immediate participation in the great struggle of practically all other important iron-making nations, and the need for war purposes with most of them for more iron and steel than their own output, precipitated upon the United States a demand far beyond anything that an export enthusiast could possibly have pictured. It began in 1915 but grew much heavier in 1916. Thus was brought about a distortion of the trade relations of the whole world. Not only were belligerents unexpectedly large buyers but neutral countries generally, that had been cut off from their usual sources of supply, became heavy purchasers of American steel. Only a portion of the details of such transactions reached the public at the time they were consummated, but enough became known to establish the fact that numerous steel purchases by belligerents were of staggering proportions; while the neutrals also showed a disposition to take greater quantities than it had been supposed their needs would require.

Export Statistics Show Magnitude of Foreign Buying

The magnitude of this foreign buying is indicated in our statistics of exports. The report of the Bureau of Foreign and Domestic Commerce of the Department of Commerce for October, the latest issue, shows that in the first 10 months of this year the value of our exports of iron, steel and manufactures thereof, excluding ore, was $701,052,410, against $294,822,223 in the corresponding period of 1915 and $251,672,076 in the corresponding period of 1913, the year before the outbreak of the European war. There was of course considerable inflation in values in 1916; hence, a comparison of the exports of iron and steel commodities whose weights are reported, and are so-called "tonnage exports," needs to be given. These exports totaled 4,968,285 gross tons in the first 10 months of 1916, against 2,818,999 tons in the corresponding period of 1913. Estimating the remaining two months of the year at the rate of the 10 months, the total exports of this class will be only a little short of 6,000,000 tons —a truly stupendous amount. As the foreign buying has not abated, American iron and steel products will for some time further play a prominent part in the world's trade. Foreign buying may also be expected to exert a continued important influence on domestic prices.

This Review Discards Chronology

The course of trade in other years has been treated somewhat in chronological order in reviews, but a record of 1916 by months or quarters would seem too commonplace a proceeding for such an extraordinary year. That method can well be followed when so little happens that the opening of a new month or a new quarter is expected in itself to bring about some change from tiresome dullness. Those who are interested in tracing the course of prices from month to month in 1916 will find ample material for such an occupation in the numerous price tables immediately following this review, which aims to present some of the most striking developments.

Demand for Steel a Special Feature

A wilder year as to prices and apparently reckless orders was never known in the American iron trade. Throughout the entire period the demand for most steel products was in excess of the productive capacity, and the distortion of trade brought about by the exigencies of the belligerents entailed peculiar consequences. The demand for large rounds for shell making was so heavy as to cause the price of that special form of rolled steel to rise far above prices of other shaped products. This was a fortunate development for steel-rail manufacturers, whose rail-making plants were being operated at only part capacity because of the en-

forced economy of railroads, as mills were diverted from rails to large bars and then ran steadily on that highly profitable work.

There was also a highly stimulated operation of forging plants throughout the country for the production of shell forgings, from steel billets, these forgings being shipped to the extent of hundreds of thousands of tons to munitions plants both at home and abroad. Foreign makers of large bars and of shell forgings turned to this country for additional blooms and billets which soon ran the price of semi-finished steel above the prices of certain finished steel products having almost exclusively a domestic market. Fabulous prices were paid for barb wire for defensive entanglements and equally fabulous contracts were placed for such wire, almost turning the wire trade topsy-turvy. Prices of all wire products advanced again and again until achievements in marking up prices in the old days of pools and combinations were equaled if not surpassed.

Railroad Buying Almost Neglected for Months

The heavy foreign demand for steel products more than covered the lack of railroad buying in the first nine months. It was perhaps fortunate for our foreign customers that the railroads were too poor until toward autumn to absorb more than a fraction of their usual consumption of the country's iron and steel products. It was fortunate for the steel manufacturers also, as their profits on export products were much greater than if they had been working as largely as usual on railroad material for domestic users.

For a long time the rail makers ignored the great advances in prices of steel in other forms and continued to quote standard steel rails to domestic railroads at the prices which had been unchanged through the vicissitudes of the steel trade since 1901, or for 15 years. Meanwhile, much higher prices were being obtained on rails sold for export. Apparently with reluctance, the rail makers finally yielded to the force of circumstances and departed from their time-honored policy of maintaining a moderate price, unchanged in either depressed or active periods. They were quite conservative in advancing, however, naming $5 per ton more at one time and another $5 per ton a few months later. Bessemer rails were thus brought up to $38 and open-hearth rails to $40 per gross ton, at mill, at which heavy contracts were placed for deliveries running far into 1918. The continued consideration shown to the railroads by the steelmakers can be measured to some extent by comparing these prices with $55 to $60 per ton for billets and sheet bars and from $90 to $110 per ton for steel tank plates, ruling in the last few weeks of 1916.

New Steel-Making Capacity Rapidly Absorbed

The course of trade in 1916 has most satisfactorily answered the question quite frequently asked early in the year—whether the huge total of new steel-making capacity then under construction would not prove too great for the country to absorb. Not only did the requirements of finishing departments and the export trade easily take the output of new steel plants as rapidly as they were completed but the demand continued to expand, always keeping ahead of the supply. At various times in the year the supply of semi-finished steel in a steel-making locality would fall so short of meeting the needs of the finishing mills that far distant steel plants had to be drawn upon.

Plates Sell Higher Than Any Other Steel Product

Advances in prices of steel products were so numerous that it was rare for a week to pass without the announcement of the marking up of some commodity. In the very first week in January wrought pipe, sheets, plates and tin plates were advanced $2 to $3 per ton.

The successive advances in plates were so great as to be spectacular. Never before were steel tank, ship and boiler plates sold at as high prices as those reached in 1916 and now prevailing. This was almost wholly due, for the greater part of the year, to the extraordinary activity in shipbuilding. Shipyards here and abroad took contracts for ships covering their berth capacity for the whole of 1917 and even into 1918, and as they took such contracts they covered for their requirements of steel plates. Higher prices asked for far distant delivery were no deterrent. Even the Chicago plate mills, remote from the seaboard, participated in the large contracts placed here by foreign shipbuilders. In the last quarter of the year the railroads, which had for many months bought so sparingly, came into the market for large quantities of steel cars, giving additional impetus to the plate market. As a result of this condition of affairs, steel-plate prices are and have long been soaring far out of line with prices of other steel products usually grouped with plates.

The general building trade was held in check to a considerable extent by the high cost of all materials, and for a large part of the year railroads were not large buyers of bridges; hence structural shapes were not in such strong demand as other rolled products. Shapes for shipbuilding, however, were called for in larger volume than ever before and the great activity in all branches of industry caused an unusually heavy consumption of structural material in the construction of new manufacturing plants and additions to old ones. Wrought pipe, bars, sheets and tinplates experienced the largest demand ever known. The trade in tubular products has run so far beyond expectation that the construction of new plants of large capacity is under way, on which work is being pushed as rapidly as possible. In the bar trade the agricultural-implement makers, who had been long accustomed to receive special consideration from the bar manufacturers, deferred their season contracting for some weeks in the belief that the great volume of their bar business would win concessions under the prices asked other consumers. But so far in excess of the productive capacity of the bar mills was the general demand that the attitude of the implement manufacturers made no impression. They finally yielded and placed contracts at the current rates, while few of them were able to obligate the mills more than six months. The trade in sheets and tin plates is especially reviewed elsewhere.

Heavy Movement Causes Unfamiliar Developments

Railroad and vessel facilities were not equal to the extraordinary requirements of the export trade

superimposed on a domestic movement of unprecedented magnitude. Merchandise for export accumulated in such volume at seaports that terminal facilities became congested, and even leading railroad systems were compelled from time to time to declare embargoes on further receipts.

The declaration of embargoes on freight is a practically new development for American business interests, accustomed to quick dispatch in transportation. At the seaboard terminals the freight congestion was largely due to the expansion of export business beyond ocean-carrying facilities, but to some extent it was caused by the inability of the railroads to set aside sufficient funds in recent years for the expansion of their terminal equipment to correspond with the growth of the country's business. Other embargoes, however, declared at interior points, were due almost entirely to the fact that the country's business had outgrown its rail transportation facilities. Cars, locomotives and sidings were inadequate to meet the demand. With increased revenues, resulting from this year's prosperous conditions, the railroads are now buying equipment much more freely but they cannot remedy in a short time the deficiency in this respect resulting from enforced economy for several years.

Allotments of product became a feature with some large producers of finished steel. As early as January an important Western steel company announced that, in view of the huge volume of business offering, it had decided to distribute proportionately among its customers such of its output for the last half of the year as it still had for sale. Other large manufacturers in the course of the year found it desirable or necessary to take similar action and some completely withdrew their traveling salesmen.

Pig Iron Jumps from Dullness to Activity

Except for a moderate buying movement in January and February, pig iron moved sluggishly for several months, and about the only quality to maintain its price was Bessemer. Foundry and basic pig iron receded to some extent in the spring and summer. Foundry iron was especially depressed by strikes of molders in various cities in an effort to secure a general eight-hour day. These strikes were almost invariably unsuccessful but they dragged along for weeks and even months, curtailing considerably the consumption of foundry pig iron. Another depressing influence was an embargo on pig iron for New England points by the New York, New Haven & Hartford Railroad which was in effect for several weeks. The great increase in basic open-hearth steel capacity failed to stimulate the basic pig-iron market until well along in the autumn. Possibly because too many furnaces changed from producing foundry iron, the supply of basic pig iron was for months fully up to, if not in excess of, consumptive requirements. The large stocks of pig iron acquired at low prices in 1915 came on the market whenever consumers showed some inclination of needing a supply.

These influences were effective in checking an advance until European buying of pig iron assumed large proportions in October and November. The appreciation of an approaching scarcity of pig iron, which followed the European buying, was sudden, causing a great contracting movement for far forward delivery. Never previously had American consumers contracted so early as October for deliveries running through the last half of the following year. The buying was so heavy that prices advanced quite notably, but they jumped when, toward the latter part of November, sales of Lake Superior iron ore for the season of 1917 were made at an advance of $1.50 per ton. In past years an advance in the price of iron ore was without effect on the pig-iron market until the approach of the time when the dearer ore was going to be used, but in 1916 trade conditions were such that it had a cumulative effect on an already excited body of pig-iron consumers.

A most interesting development of the year was the growth of the production of ferromanganese in this country. Early in the year much alarm was caused among steel manufacturers by restrictions imposed by the British Government on exports of ferromanganese from the United Kingdom, the main source of our supply. The price of 80 per cent rapidly rose until in June $250 per ton was not an unusual amount to pay on contracts, while as high as $450 was paid for small lots. Meanwhile the usual competitive forces that develop in a time of stress were at work, and in addition to the United States Steel Corporation quite a number of operators of blast furnaces arranged for the importation of Brazilian and other manganese ores and the domestic production of ferromanganese rapidly increased, bringing the British price down to $164, seaboard, with some domestic alloy sold at the time of greatest competition in November at about $155 at a Central Western point.

Coke Advanced Instead of Declining

Coke furnished one of the surprises of the year. So many blast-furnace owners had built or begun to build by-product ovens to make their own coke that for a considerable time the belief widely prevailed that the free supply of coke in the last half of the year would be more than ample for furnace requirements. For this reason coke producers early in the year were willing to enter last half contracts at a lower price than they named for the first half. Special weakness was shown in June and the situation then suddenly changed. Scarcity of labor developed not only in coke regions but in construction work on coke ovens, and coke shipments began to be hampered by scarcity of cars, while blast-furnace operations increased to meet the demand for pig iron. Prices of coke mounted to an unprecedented altitude and have not yet begun to decline.

Conclusion

Earnings of steel companies in 1916 exceeded all expectations. Those carrying a burden of floating indebtedness lightly cast it aside and substituted the more cheerful process of piling up a surplus. It was a record year for the wiping out of deferred dividends on cumulative-dividend stocks as well as for the declaration of extra distributions of profits. In this latter respect, however, steel companies have been decidedly conservative. Mindful of the lean years sure to come, they have preserved substantial surpluses and are thus facing the future with far less apprehension than ever before.

Labor has shared in the prosperity of the year.

Three times in the twelvemonth were wages of laborers advanced by the steel manufacturers, each time 10 per cent, while workmen paid on a sliding scale were steadily benefited by the rising prices of the products they made. It is safe to say that never before, in this or any other country, were iron and steel workers in receipt of such incomes from their daily toil as the workmen of this country in 1916.

Although conditions at the close of 1915, when the demand was insatiable, looked as if they would never again be equaled, they were far surpassed by the achievements of 1916. The contracts for far distant delivery placed at high prices in the last two months of the year plainly showed a disposition to speculate on the indefinite continuance of the war. Although prices have long been regarded as dangerously high, the belief of some in the steel trade is that when readjustments come they will be gradual and not so violent as to cause disaster. On the other hand are those who emphasize the possibility of radical changes in prices after the war and also of the competition of foreign-made steel products in this market.

Features of the Chicago Iron Trade in 1916

BY O. J. ABELL

In the accompanying tabulated form are shown the average monthly prices throughout 1916 of typical grades of pig iron, finished material and scrap, based on sales in the Chicago market. The record of these prices shows some tendencies, in the course of the year, which probably would not command attention among general impressions.

The Pig-Iron Market

Prices of pig iron advanced slightly through the first quarter of the year, remained stationary in the second quarter and sagged perceptibly in the third. Recovery of strength in the pig-iron market began in October and became most rapid in November. The maximum range of prices of Northern iron in the period of the year was approximately $12 per ton, from a minimum of $18 to a maximum of $30.

Relations of Structural Shapes and Steel Bars

Two interesting facts are to be noted from the prices given for structural shapes and steel bars. The prices shown are those generally prevailing for prompt shipment, as contrasted with contract quotations for deliveries only at mill convenience. Sales of steel in the West at prompt shipment prices were a very much smaller proportion of the whole tonnage used than was true in districts depending upon Pittsburgh and Eastern producers. The reason for this goes back to the fact that Western mills were much slower in acquiring a backlog in 1915 and the early part of 1916 than were the more easterly mills, and accordingly shipments against their contract obligations went forward to customers in a manner to meet the latter's needs without the necessity of buying prompt shipment material to a much greater extent than was true elsewhere. Almost throughout the year users of structural shapes and bars in the West were working on material for current orders at a decidedly lower price level than were Eastern contemporaries. The higher premium level of prices was therefore less indicative of conditions in the West than in the East.

Another interesting fact made apparent in a comparison of the prices of structural material and soft steel bars is that in the early part of the year bars were selling at higher prices than shapes. In the third quarter, prices of both shapes and bars for prompt shipment became almost the same as contract quotations, while in the last quarter of the year structural steel began to sell again at the normal spread in advance of bars. Partial explanation of these changing relationships lay in the curtailment of structural steel projects as the result of high prices.

Old Material Low for 10 Months

The interesting feature about the prices of [illegible] rials as compared with the prices prevailing [illegible] materials was the disproportionately low level which obtained through 10 months of the year. Not until the acute car and labor shortages made themselves most keenly felt at the approach of winter did the scrap market begin to gain strength, following which the advance in prices has had few parallels for rapidity.

The following tables show the course of prices in the Chicago market in 1916, compiled from the weekly reports in THE IRON AGE:

Average Chicago Prices of Pig Iron

	Northern Coke No. 2	Lake Superior Charcoal	Southern Coke No. 2
January	$18.50	$19.50	$18.88
February	18.50	19.75	19.00
March	18.70	19.75	19.00
April	19.00	19.75	19.00
May	19.00	19.75	19.00
June	19.00	19.75	18.70
July	19.00	19.75	18.25
August	18.40	19.75	17.80
September	18.13	19.75	18.13
October	19.63	20.25	19.25
November	25.80	26.46	23.70
December	29.50	31.75	27.50
Average for year	20.25	21.33	19.85
Average for 1915	$14.02	$16.10	$14.73
Average for 1914	13.60	15.60	14.46
Average for 1913	15.95	16.50	16.12
Average for 1912	15.32	16.77	16.11
Average for 1911	14.87	16.96	14.80
Average for 1910	17.10	18.67	16.30
Average for 1909	17.49	19.50	17.30
Average for 1908	17.57	20.24	16.76
Average for 1907	24.50	26.56	24.47
Average for 1906	20.43	20.72	19.44
Average for 1905	17.65	17.99	16.66
Average for 1904	14.37	15.50	13.92
Average for 1903	19.26	22.13	18.31
Average for 1902	20.86	23.50	20.10
Average for 1901	15.38	17.50	14.60
Average for 1900	19.47	22.00	18.35

Average Chicago Base Prices of Finished Iron and Steel

	Common Bar Iron. Cents	Soft Steel Bars. Cents	Structural Steel. Cents
January	1.79	2.44	2.38
February	1.90	2.52	2.44
March	2.16	2.89	2.59
April	2.35	3.07	2.74
May	2.35	3.19	2.79
June	2.35	2.99	2.79
July	2.35	2.94	2.79
August	2.35	2.94	2.89
September	2.35	2.94	2.94
October	2.35	2.94	2.94
November	2.55	3.02	3.19
December	2.88	3.34	3.44
Average for year	2.31	2.94	2.83
Average for 1915	1.24	1.48	1.48
Average for 1914	1.06	1.32	1.34
Average for 1913	1.43	1.65	1.60
Average for 1912	1.32	1.42	1.46
Average for 1911	1.22	1.47	1.50
Average for 1910	1.45	1.62	1.66
Average for 1909	1.43	1.50	1.59
Average for 1908	1.56	1.66	1.82
Average for 1907	1.78	1.77	1.87
Average for 1906	1.71	1.68	1.84
Average for 1905	1.65	1.65	1.75
Average for 1904	1.41	1.50	1.71
[illegible]	1.65	1.72	1.75
[illegible]	1.71	1.73	1.75
[illegible]	1.58	1.58	1.70
[illegible]	1.75	1.75	2.00

Average Chicago Prices of Old Material

	Cast Borings, Net Ton	No. 1 Railroad Wrought, Net Ton	Heavy Cast Scrap, Net Ton	Heavy Melting Steel Scrap, Gross Ton	Old Steel Rails, Rerolling, Gross Ton
January	$7.75	$15.88	$13.31	$15.50	$17.06
February	7.38	14.94	12.81	14.75	17.06
March	7.40	16.20	13.45	16.50	17.65
April	7.00	17.00	12.88	16.50	18.00
May	6.75	16.50	12.56	15.94	17.38
June	5.75	15.20	11.75	14.80	15.85
July	5.69	14.94	11.50	14.50	15.25
August	6.05	15.30	11.50	15.25	15.80
September	6.50	16.38	12.13	16.06	17.06
October	6.81	17.50	13.50	16.81	18.81
November	7.50	21.00	15.55	20.60	24.50
December	9.19	25.13	16.25	23.00	28.63
Average for year	6.98	17.16	13.10	16.68	18.59
Average for 1915	$5.57	$10.27	$9.96	$10. 1	$11.73
Average for 1914	4.61	8.66	9.70	9.37	10.96
Average for 1913	5.36	10.80	10.44	10.90	13.33
Average for 1912	6.67	12.54	12.29	12.12	14.19
Average for 1911	5.34	11.23	11.08	10.92	12.91
Average for 1910	5.50	12.99	13.32	13.43	16.34
Average for 1909	6.37	13.76	13.79	14.45	15.82
Average for 1908	5.37	12.45	12.69	12.45	14.40
Average for 1907	8.78	14.63	17.26	15.08	17.53
Average for 1906	8.69	15.62	14.55	14.74	17.15
Average for 1905	8.57	16.14	13.50	13.97	15.02
Average for 1904	4.72	12.45	10.95	10.72	12.54
Average for 1903	7.33	16.07	14.75	15.50	19.04
Average for 1902	8.89	19.68	15.03	17.37	23.35
Average for 1901	4.20	15.00	11.25	12.84	16.05
Average for 1900	6.65	15.00	11.00	12.84	15.50

The operations of the iron and steel plants in the Chicago district were on a greater scale than in any previous year. Not only was the demand from Chicago's natural territory in excess of anything experienced before, but the manufacturing resources of the district were drawn upon to assist in supplying the urgent wants of consumers in other trade centers and even in foreign countries. There have been times in past periods of activity when a lull has prevailed of more or less duration, but in 1916 the activity was sustained up to the limit of productive capacity from the opening of the year to its close. As prices averaged much above those of 1915 and the production was much greater, it follows that the volume of business in dollars and cents must have greatly exceeded that of any previous year.

Further Comparison of Chicago Prices

In another portion of this issue of THE IRON AGE will be found comparative tables giving prices at Chicago of local No. 2 foundry pig iron, Lake Superior charcoal pig iron and leading varieties of old material which cover a long series of years. These tables have been given separately because of their size and also because the information thus given is of such importance as to justify special treatment.

Features of the Pittsburgh Iron Trade in 1916

BY ROBERT A. WALKER

The Course of the Pig-Iron Trade

The year 1916 in the pig-iron trade was a record-breaker in almost every way. The output in the United States was greater than in any previous year, and prices, especially in the last half of the year, showed some surprising advances. The year opened with Bessemer pig iron selling at $21; basic, $18; No. 2 foundry, $18.50, and gray forge, $17.50, all at Valley furnace. Advances in prices the first half of the year were few, but in the last half they came along rapidly, especially in December. Bessemer iron sold in that month at $35, basic at $30, No. 2 foundry as high as $32, and gray forge at $29, all at Valley furnace. At the close of the year every blast furnace in the Pittsburgh and in the Mahoning and Shenango valley districts was active that could be operated, but in the last several weeks of the year some were banked because of a shortage in coke.

No new blast furnaces were built in the Pittsburgh or Valley districts, but the Republic Iron & Steel Company is building a new furnace at Haselton, Ohio, and the Carnegie Steel Company completely rebuilt one of its Bellaire furnaces. The Youngstown Sheet & Tube Company contemplated a new blast furnace, but it was deferred because of the high prices of materials and labor. The following table gives the monthly prices in 1916, averaged from weekly reports in THE IRON AGE of Bessemer, basic, No. 2 foundry and gray forge iron at Valley furnace, to which 95c. per ton should be added for delivery in the Pittsburgh district:

Average Monthly Pig-Iron Prices, f.o.b. Valley Furnace—Per Gross Ton

Month	Bessemer	Basic	No. 2 Foundry	Gray Forge
January	$20.62	$17.81	$18.50	$17.50
February	20.31	17.69	18.31	17.50
March	20.80	18.20	18.50	17.50
April	21.00	18.13	18.50	17.75
May	21.00	18.00	18.20	17.75
June	21.00	18.00	18.13	17.75
July	21.00	18.00	18.25	17.75
August	21.00	18.00	18.25	17.75
September	21.31	18.31	18.39	17.94
October	23.12	19.88	20.00	19.50
November	29.10	25.10	25.60	25.00
December	34.62	30.00	30.75	29.00

Semi-finished Steel

The course of the market in 1916 in Bessemer and open-hearth steel rerolling billets, sheet bars and forging billets was without precedent. The heavy drain on the steel mills for war steel had the effect of putting prices on billets and sheet bars to extraordinary figures, the year closing with soft Bessemer and open-hearth billets and sheet bars selling at the highest prices ever known. However, most consumers of billets and sheet bars have contracts of various kinds, some on a sliding scale basis and others at flat prices, and were getting their steel at considerably under what was being charged to consumers who had to purchase in the open market.

Very large additions to open-hearth steel capacity in the Youngstown, New Castle and Pittsburgh districts were made. The Brier Hill Steel Company built four 100-ton open-hearth furnaces at Youngstown, while the Youngstown Sheet & Tube Company built three and is building three more. The Carnegie Steel Company made large additions to its open-hearth capacity at the Ohio works, Youngstown; Farrell works at Farrell, Pa., and at other plants. In the Pittsburgh district the Pittsburgh Steel Company completed four 60-ton open-hearth furnaces, the last one having started in December. It is estimated that the increased capacity in open-hearth steel in the Pittsburgh, Youngstown and New Castle districts at the close of 1916 was 3,000,000 to 3,500,000 tons annually. Nevertheless, there was practically a famine in the supply of Bessemer and open-hearth steel, particularly in the last half of the year, and this interfered materially with the output of sheets, tin plate and other products.

The year opened with soft Bessemer and open-hearth billets selling at $32 to $33, and sheet bars about $35, f.o.b. Pittsburgh. At the end of the year soft Bessemer and open-hearth billets and sheet bars had sold at $60 and above, and, in fact, $65 was reported to have been paid for several lots of billets sold late in December. Forging billets advanced from about $55 to $80 or higher. High carbon forging billets sold in the latter part of the year as high as $90, Pittsburgh.

Finished Iron and Steel

The demand for finished iron and steel of all kinds surpassed all previous experiences, and this is also true of output. Prices advanced to unheard-of figures, mills were congested with orders during the entire year, and deliveries to consumers were bad, especially in the last quarter, when a very serious shortage developed in the supply of cars.

The year opened with structural steel shapes selling

at 1.80c. to 1.90c., but advances were numerous. At the close of 1916 the Carnegie Steel Company was quoting 3.10c. on shapes, but was filled up for a year ahead. The Jones & Laughlin Steel Company was quoting from 3.10c. to 3.25c. for beams and channels up to 15 in., but was filled up for six months or longer. Plates made a great record in 1916, the wonderful revival in demand in the shipbuilding and steel-car trades being responsible for a famine in plates for nearly the entire year and for record prices. When January opened, ¼-in. and heavier sheared plates were selling at about 1.80c. to 2c. for delivery at convenience of the mill, which at that time would have been probably three to four months, while for shipment in three to four weeks plates were 2.25c. to 2.50c. at mill. Prices advanced steadily during the year, and as high as 5.50c. was paid for sheared plates in fairly large lots for prompt shipment.

The demand for iron and steel bars in 1916 was enormously heavy, being much beyond the capacity of the mills to supply as promptly as desired by customers. In fact, all through the year the mills were far back in deliveries, and the year closed with the Carnegie Steel Company practically sold up on steel bars for all of 1917 and other large producers through the first half of the year. The year opened with steel bars selling at 1.80c., which was a nominal price for delivery at convenience of the mill, and about 2c. where mills could promise delivery in six to eight weeks. It closed with the nominal price on steel bars of the Carnegie Steel Company 3c., but mills that could ship in the last part of the first quarter and during the second quarter were getting as high as 3.25c. The price on iron bars at the beginning of 1916 was about 2c., and at the close of the year several local mills were quoting as high as 3.25c. at mill, in carload and larger lots.

The demand for wire and wire products of all kinds was far in excess of anything known in the history of the business. A very large export trade was done during nearly all of the year in wire and wire nails. England, Russia and France placed enormous orders in this country for barb wire and other kinds, while from nearly every foreign country, notably Canada, there were very heavy demands for wire, wire nails and rods. The year opened with wire nails selling at $2.10; plain annealed wire, $1.95, and galvanized barb wire, $2.95, f.o.b. Pittsburgh. Advances during the year were numerous. On Jan. 24 plain wire and wire nails were put up $2 per ton; Feb. 14, $2; Feb. 29, $2; May 1, $2; Aug. 1, $2; Oct. 18, $2; Nov. 4, $3, and Nov. 27, $3. Barb wire advanced even more rapidly.

Wrought-Iron and Steel Pipe

The year 1916 made a record in prices, demand and output of both iron and steel pipe. No less than 12 different advances were made in prices of pipe, and the year closed with mills sold up on lap-weld pipe through the first half of 1917. In the case of two or three of the larger producers, orders already on their books and business that will come to them from regular customers will practically take their entire output for all of 1917. On Jan. 4 there was an advance of $2 per ton on black and galvanized steel pipe; Jan. 20, $2; Feb. 16, $2; Feb. 29, $2; March 15, $2; March 29, $2; April 21, $2 on butt-weld, $6 on lap-weld black pipe and $4 on galvanized. On July 24, owing to the severe decline in spelter, prices on galvanized pipe were reduced about $10. On Sept. 7 prices on butt-weld steel pipe advanced $2, and on lap-weld, $4. On Nov. 1 prices on lap-weld steel pipe were advanced $2. On Nov. 15 butt and lap-weld were advanced $2, and on both Dec. 4 and 29 $4. From Sept. 7 to Dec. 29 prices were advanced about $16 per ton. Prices on locomotive and merchant iron and steel boiler tubes were also sharply advanced.

The Coke Trade

The demand for coke throughout the year was unusually heavy, especially in the last half, when blast furnaces were driven to their utmost capacity to meet the demand for pig iron. The year was characterized by the building of a large number of by-product coke plants. At the opening of 1916 the best grades of Connellsville furnace coke were selling for prompt shipment at $3.25 to $3.50 and on contracts at about $2.50 per net ton at oven, with foundry coke at $3.50 prompt and $3.25 on contract. At the close of the year there was a coke famine, due to shortage in cars and motive power, and in the last week of December sales of furnace coke were made as high as $11 and $12 and of foundry coke up to $10 or more per net ton at oven. The following table shows monthly prices per net ton at oven on prompt and contract furnace and foundry coke in 1916, averaged from weekly market reports:

Prices at Oven of Connellsville Coke in 1916—Per Net Ton

	Prompt Furnace	Contract Furnace	Prompt Foundry	Contract Foundry
January	$2.94	$2.50	$3.50	$3.25
February	3.38	2.50	3.50	3.25
March	3.47	2.87	3.75	3.50
April	2.41	2.67	3.56	3.37
May	2.30	2.50	3.25	3.25
June	2.49	2.50	3.25	3.45
July	2.75	2.50	3.25	3.50
August	2.80	2.50	3.30	3.50
September	2.94	2.65	3.31	3.50
October	4.88	3.38	3.88	4.06
November	7.20	3.85	8.70	4.90
December	8.37	4.12	8.62	5.75

Old Material

The market on old material did not come into its own as regards prices until late in 1916. Prices on all grades of scrap were low for the first nine months. Occasional spurts took place, when prices advanced, but in most cases these did not hold. However, in the last three months of the year, particularly in December, there were heavy advances on all kinds of old material, with heavy steel scrap selling up to $26 and $27, low phosphorus melting stock as high as $36, borings and turnings at $13 and $14, and other grades in proportion. The peace overtures from Germany then gave the market a setback, and there was a decline in the last week of the year of $1 to $3 per ton. The following table shows monthly prices on several classes of scrap averaged from weekly market reports:

Old Material Prices, Pittsburgh, 1916—Per Gross Ton

	No. 1 Cast	Bundled Sheet Scrap	Rerolling Rails	Cast-Iron Borings	Machine-Shop Turnings
January	$15.50	$14.25	$18.10	$10.75	$9.87
February	15.62	14.19	17.62	10.69	9.50
March	16.05	14.40	18.10	11.05	10.35
April	16.12	14.31	17.95	10.94	10.60
May	12.19	13.50	17.38	9.95	9.80
June	15.90	12.80	16.20	8.95	9.10
July	15.56	16.44	12.19	8.31	8.21
August	14.80	16.10	11.15	7.70	7.50
September	14.62	16.87	11.19	8.12	7.06
October	15.75	18.75	11.38	8.87	7.50
November	17.20	23.90	13.40	10.10	8.70
December	21.87	29.25	17.12	14.00	12.75

Heavy Melting Steel Scrap Prices, Pittsburgh

The appended table gives the average monthly prices of heavy melting steel scrap at Pittsburgh for 16 years, comprising 1901 to 1916, inclusive. These prices are per gross ton and are averaged from weekly quotations in the Pittsburgh iron market report of THE IRON AGE.

	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916
January	$13.00	$17.40	$21.20	$12.50	$16.25	$17.25	$18.95	$12.80	$16.63	$17.69	$13.50	$12.75	$14.95	$13.62	$11.63	$17.50
February	14.50	17.63	21.13	13.50	15.88	16.31	18.06	13.88	15.63	17.25	14.13	12.12	14.19	12.62	11.63	17.06
March	16.00	18.50	21.00	14.00	15.90	14.70	18.00	13.19	14.19	16.80	14.35	12.62	14.19	12.12	12.00	18.45
April	16.50	19.00	21.50	13.63	16.00	14.75	17.94	12.80	14.00	16.50	13.06	13.06	14.19	12.00	11.81	17.81
May	17.00	20.00	21.25	12.13	15.00	14.80	18.10	12.81	14.81	15.30	12.62	13.25	13.55	12.00	11.75	16.95
June	17.50	21.25	20.00	11.30	13.90	15.63	18.38	13.13	15.69	15.10	12.95	13.44	12.62	12.00	11.75	15.88
July	17.00	21.90	19.70	10.75	14.00	15.75	18.06	14.25	15.90	14.50	13.06	13.34	12.40	12.00	12.31	16.31
August	16.00	21.00	18.50	11.38	14.85	16.50	17.75	14.81	16.31	14.31	13.20	13.55	12.37	11.50	13.81	16.05
September	15.00	21.50	17.25	11.50	15.88	16.88	17.38	14.25	17.40	14.35	12.50	14.11	12.25	11.31	14.30	16.19
October	17.50	21.50	15.30	12.25	16.50	17.13	17.10	15.20	17.94	14.25	12.06	15.85	11.85	10.85	14.38	18.25
November	18.00	21.00	13.25	14.25	17.50	18.00	14.88	16.06	17.50	14.25	12.00	15.12	11.44	10.00	15.88	21.20
December	17.50	21.00	11.20	16.20	17.63	20.00	13.00	16.70	18.00	13.75	12.31	14.75	11.08	10.75	17.45	26.00

The Steel Trade in Eastern Pennsylvania in 1916

BY CHARLES LUNDBERG

The demand on eastern Pennsylvania steel mills in 1916 was such that they frequently ignored Pittsburgh base prices, but this is not surprising when it is recalled that many Western consumers came East for material. An impetus was given to Eastern mills which will carry them far.

The entire world sought plates, especially for shipbuilding, from the Eastern mills, and prices steadily progressed to higher levels, with deliveries the paramount question. Time and again plate makers advanced their quotations thinking to keep business away, but to no avail. Nevertheless, prices throughout 1916 showed considerable variance, but at the close of the year the quotations of the various makers were close together. Early in January 2.159c. to 2.659c., Philadelphia, was quoted for tank steel, while late in December 4.159c., Philadelphia, was quoted for universal plates, 4.909c. to 5.159c. for tank plates, and 6c. and upward for ship plates.

Quotations for structural steel receded in August, dropping from 3.159c. to 2.759c., Philadelphia, but in October the 3c. level was reached again. New factories, steel plants and shipyards created the bulk of the demand for fabricated material. In August Bessemer steel undersold open-hearth material, but this condition was but temporary. The mills enter 1917 comfortably booked over the first half.

Steel bars also saw a decline about the middle of the year for which the offering of Bessemer steel, at lower prices than prevailed for open-hearth, was at least partly responsible. Last-half contracts for bars were heavily covered at 2.659c., Philadelphia. In January they were quoted at 1.959c., Philadelphia. In September Bessemer bars were quoted at 3.159c., and thereafter but little was heard of them. Throughout the year discarded shell steel was in great demand for concrete reinforcing bars.

Pig Iron's Skyrocket Advance

After advancing in the first quarter, pig-iron prices lagged in the next two quarters, touching the low point in September on foundry grades, and in July on basic and low phosphorus. Foundry grades did not keep pace in activity or price with steel-making irons. Resale foundry iron was a factor in keeping prices down. At the beginning and end of the year the furnaces were hampered by transportation troubles and uncertain deliveries of coke. In the year both Western and Southern basic were taken by eastern Pennsylvania steel makers. The export demand was heavy, first for Bessemer and low phosphorus, then for iron in general. Stocks on furnace banks Aug. 1 were the lowest in years. The sensational advances of the last quarter are such recent history as scarcely to need comment. The following table of monthly averages indicates the course of prices throughout the year:

Average Prices of Pig Iron, Prompt Delivery in Buyers' Yards, Eastern Pennsylvania and Nearby Points, in 1916.

	Penna. No. 2 X	Virginia No. 2 X	Standard Gray Forge	Basic	Standard Low Phos
January	$19.94	$19.94	$18.44	$19.50	$32.00
February	19.85	20.60	19.00	19.50	32.00
March	19.94	20.75	19.00	19.62	32.00
April	20.44	21.25	19.12	20.62	33.75
May	20.50	21.25	19.50	20.50	34.00
June	19.94	21.25	19.25	19.69	33.50
July	19.75	21.25	18.50	19.12	33.25
August	19.55	20.50	18.50	19.15	34.00
September	19.50	20.25	18.50	19.75	34.25
October	20.75	21.05	19.35	20.60	38.00
November	25.50	27.06	23.75	26.00	46.00
December	29.25	29.19	27.69	30.00	51.00

Old Material Market Disappointing

An oversupply of old material, coupled with embargoes on important points, were primary reasons for a market which dragged until November. Then, with prices advancing in a rush, business became active, particularly in specialties. Heavy melting steel did not respond so readily, but its local price was supported by the great demand in the West. In December, before business of large proportions could ensue, a quietus was put on the entire market and prices were rendered nominal by the German peace proposal. Herewith are given average monthly prices of low phosphorus, iron rails, wrought-iron pipe, stove plate and railroad malleable scrap, the averages of other items appearing elsewhere in this issue of THE IRON AGE:

Average Prices of Low Phosphorus Steel, Iron Rails, Wrought Pipe, Stove Plate and Railroad Malleable Scrap, Delivered in Buyers' Yards, Eastern Pennsylvania, in 1916, *Per Gross Ton*

	Low Phos. Steel	Iron Rails	Wrought Pipe	Stove Plate	Railroad Malleable
January	$21.50	$19.50	$16.00	$13.00	$15.00
February	21.50	19.50	15.15	13.00	15.00
March	22.25	19.62	15.19	13.62	15.00
April	22.50	20.00	15.12	13.87	14.87
May	22.50	20.00	14.00	13.20	14.75
June	22.00	20.00	12.84	12.25	13.87
July	20.50	20.00	12.50	11.75	13.50
August	20.80	20.00	12.70	11.75	13.50
September	21.25	20.00	14.25	11.75	13.50
October	22.20	20.80	15.95	13.15	13.50
November	27.12	23.00	17.25	14.87	16.12
December	33.00	26.75	18.75	17.00	18.25
Average, 1916	23.09	20.76	14.98	13.27	14.74
Average, 1915	16.56	15.61	11.71	9.65	10.10
Average, 1914	10.38	14.75	7.96	8.69	9.17
Average, 1913	11.97	17.56	11.39	9.86	11.85

Cincinnati Iron Trade Conditions in 1916

BY CHARLES L. SMITH

Outstanding features of the Cincinnati iron market in the year just ended were the rapid advances in prices of both Northern and Southern pig iron made in the last quarter. The difference in quotations on January 1 and December 1, was approximately $5 per ton, and prices in the third week of December would make this difference about $9 per ton. Southern iron, in this great advance, did not reach an equal level in this market with Northern brands. This is accounted for by the enormous export and domestic demand for steel, requiring so much basic iron that it took up a large part of the output of Northern furnaces.

Pig iron is now selling at the highest prices of many years. In past boom periods—in 1872-3 and 1879-1880—it reached a higher level, but no long-time contracts were made then at maximum quotations. The difference in present conditions is shown by the fact that some furnacemen in both the North and the South have been able to sell a large part of their output at the advanced figures quoted in the last three months of the year for delivery in the last half of 1917, and in a few cases shipments are to be extended through the first quarter of 1918.

More Virginia iron was sold in this territory in 1916 than in any previous year, as far as can be ascertained by competent authorities.

How the Market Changed Through the Year

While at the beginning of the year the market was soft, in the second week of January prices went up from 25c. to 50c. per ton on all grades. Not much business was transacted and practically all that was booked was at the personal solicitation of traveling salesmen. The situation changed almost over night in the middle of February, and business was good for some time. The total sales of basic made by Ironton

and Lake furnaces to nearby rolling mills in February and March amounted to over 60,000 tons, with shipments in some cases to extend through the year. A Southern producer also sold 20,000 tons of basic. Malleable was also very active.

From the beginning of the month, April was unusually quiet. Disturbed labor conditions affected the local foundry market in May, and as a whole the month may be considered a rather dull one. Resale iron, offered both in the North and in the South, had some effect in softening prices. A few Southern furnaces were also disposed to take on some backlog business for future shipment at 25c. to 50c. per ton below the regular market quotation. The first half of June was also quiet and only a few scattered sales were reported.

A severe strain was put on Southern prices through the month of July on account of resale iron that had to be moved, and, as shown by an accompanying table, it was the lowest-priced month of the year. Early in August the Southern Ohio rolling mills bought 30,000 tons of Northern basic for shipment in the first quarter of 1917. Another consumer later in the same month purchased 20,000 tons of Southern basic, and it was estimated that a total of 139,000 tons of both Northern and Southern basic was sold to the nearby rolling mills in August and September, some of the shipments being extended to July 1, 1917. Prices advanced in the middle of September, although Southern resale iron was still a factor to be considered. An advance of $1 per ton was made on Northern iron in October that was well maintained, as there was little resale iron in that territory to offer. In the last half of the month a large tonnage of Virginia iron was sold.

Advances in November were phenomenal, and the foundry business was especially good. Southern iron in the first part of the month was selling at $17, Birmingham, but went up nearly $4 per ton before December. Numerous contracts were made for last half shipment of 1917. Prompt and first half business was light as most of the furnaces had sold up for that period, and there was little warrant iron to relieve the situation. The same condition existed in the first two weeks of December, and it was almost impossible to buy prompt iron below $24, Birmingham, except in cases where the iron had been shipped to merchants on contracts and had to be disposed of. A number of sales were made for first half shipment as high as $25 for No. 2 foundry. Northern iron advanced to $30, Ironton, for any shipment in 1917, although the furnaces in that district were practically unable at the close of the year to take on any business for first half shipment.

Actual Invoice Prices at Cincinnati

The subjoined table is prepared from the records of a prominent local pig-iron house and represents the average invoiced price of No. 2 foundry iron at Birmingham during 11 months up to Dec. 1. It will be noted that September and October, 1916, showed a decline, which is accounted for by the shipment of some low-priced prompt iron that was sold in the months of June and July. It is interesting to compare the prices of the two years.

Actual Prices of Southern No. 2 Foundry Iron Based on Shipments

	1916.	1915.
January	$11.657	$9.982
February	12.729	10.065
March	13.164	10.115
April	13.568	9.957
May	13.779	9.8661
June	13.978	9.80
July	14.386	9.82
August	14.612	9.853
September	14.444	9.911
October	14.472	10.24
November	14.698	10.321

The following table shows the range of prices at Cincinnati on leading grades of pig iron and scrap, averaged from weekly quotations in THE IRON AGE:

Prices of Leading Grades of Pig Iron and Scrap

	Southern No. 2. Gross Ton.	Northern No. 2. Gross Ton.	No. 1 Railroad Wrought. Net Ton.	No. 1 Machinery Cast. Net Ton.	Heavy Melting Steel. Gross Ton.
January	$17.90	$19.51	$13.75	$13.75	$14.37½
February	17.90	19.63½	13.31¼	13.31¼	13.81¼
March	17.90	19.76	13.60	13.60	14.55
April	17.90	20.26	14.31½	13.05	14.05
May	17.90	20.26	13.56¼	13.06¼	14.36¼
June	17.34	20.36	13.35	12.85	14.10
July	16.90	19.76	13.25	12.75	14.06¼
August	16.70	19.76	13.40	12.85	14.05
September	17.28	19.51	14.18¾	13.31½	14.50
October	18.03	20.83	15.05	14.31½	15.31½
November	22.40	24.88½	18.06¼	16.31¼	17.87½
December	25.90	31.26	21.38	18.13	20.75

The market for old material lagged all through the year until well in the last quarter. While the rolling mills and foundries melted a larger quantity than usual, the supply was much greater than the demand. The yards continue fairly well stocked, although the offerings from the railroads in December fell off to a considerable extent.

The Sheet and Tin-Plate Trades in 1916

BY B. E. V. LUTY

Profits were very unevenly distributed among the various sheet and tin-plate producers in 1916. It was a year of rapidly advancing prices, and the producers who sold the shortest distance ahead were as a rule those who made the most money. In the sheet industry a further divergence was due to the fact that prices for blue annealed sheets were particularly high and the plants that chanced to be equipped with jobbing mills made particularly large profits in those departments.

The production of black sheets in 1916 was not exceptionally heavy, as there was no especially great demand for black sheets for consumption in the black, while the demand for galvanized sheets was distinctly light. The total production of the sheet industry, however, was very large, by reason of the unusually strong demand for blue annealed sheets. The tin-plate production was about 30 per cent in excess of the previous record. Monthly averages of prices in 1916 are given herewith.

Averages of Prices at Pittsburgh in 1916

	Black Sheets, No. 28, Cents	Galvanized Sheets, No. 28, Cents	Spelter, East St. Louis, Cents	Blue Annealed Sheets, No. 10, Cents	Tin Plate 100-Lb., Base Box, Dollars
January	2.60	4.75	18.01	2.55	3.75
February	2.60	4.75	19.92	2.65	3.96
March	2.71	4.75	17.91	2.85	4.19
April	2.85	5.00	18.44	2.95	4.50
May	2.89	4.94	15.75	3.00	5.30
June	2.90	4.69	12.62	3.00	5.81
July	2.90	4.38	5.52	2.90	6.00
August	2.90	4.21	8.92	2.90	5.95
September	2.93	4.18	9.06	2.90	5.75
October	3.23	4.41	9.83	3.15	5.81
November	3.65	5.18	11.75	3.66	5.97
December	4.31	6.00	11.14	3.65	6.63
Year 1916	3.04	4.77	13.57	3.01	5.30
Year 1915	1.94	3.85	14.16	1.49	3.19

Black and Galvanized Sheets

As was the case in 1915, the black sheet market suffered from the fact that there was a light demand for galvanized sheets, and there was correspondingly more material available in the black form. The great rise in spelter in the fore part of 1915, due to the war, brought about high prices for galvanized sheets and the consumption was restricted. That was not the whole story, moreover, as many sheet mills were caught short of spelter and had to deliver galvanized sheets at a great loss. They resolved not to be caught again. Some withdrew from the trade entirely, while others made no effort to press sales.

An influence that tended to counterbalance was the fact that some of the sheet interests, with steel plants attached, accepted a great deal of shell-steel business and did not have sufficient steel left to operate their sheet departments at capacity. At the close of the year a few were almost entirely idle. The meagerness of the offerings at that time helped to send prices upward rapidly. The black sheet market advanced in 1916 from 2.60c. to 4.50c. per lb., or $38 per net ton. The midway price was reached about Nov. 1. In other words, the market advanced by the same amount in the last two months of the year as it had in the first 10.

Early in the year the spread between black and galvanized sheets, both No. 28, with spelter at 18 to 20c., averaged about $2.15 per 100 lb. In the summer, when spelter dropped below 10c., the spread decreased to about $1.30. At the end of the year, however, with spelter not much higher, the spread had increased to about $1.75.

Blue Annealed Sheets

In the fore part of the year the curious condition prevailed in the market that for delivery in, say, two or three months, plates ¼-in. and heavier were at one price, No. 10 blue annealed sheets at a lower price, and No. 28 black sheets at a still lower price. This inversion of the natural order of things was due to the extremely heavy demand for plates, largely on account of activity in the shipbuilding industry. In the circumstances the plate mills refrained from taking orders for light plates, throwing this business to the jobbing mills and giving them more than they could handle comfortably. At several plants the effort was made to roll blue annealed sheets on regular sheet mills, with results more or less satisfactory. Apart from the jobbing mills being offered a great deal of light plate business for which the plate mills would ordinarily compete there was an unusually heavy demand for blue annealed sheets in the ordinary gages, due to the unprecedented activity in the automobile industry.

The Form of Sheet Contract

At a meeting of the National Association of Sheet and Tin-Plate Manufacturers held in the William Penn Hotel, Pittsburgh, in July, 1916, a resolution was adopted that contracts for the sale of sheets should be binding, and that there should be no expressed or implied understanding that prices should be readjusted in case of a falling market. Later, a contract form was carefully worked out and recommended to members for their adoption. This contract form involves a number of innovations, but by far the most important is the introduction of two paragraphs providing respectively for damages to be collected by the buyer or the seller in case the other party fails to live up to the contract.

The proposed reform, if successful, should prove profitable to the mills. Whether, other conditions being equal, the market could advance more rapidly under the old or the proposed system is a question. That it would be less disposed to decline, under adverse conditions, seems very probable. Being assured of orders, the mills would be less disposed to cut prices, while, under the old system, the transition of the mills from a state of being apparently well sold up to a state of having contracts, but no specifications to roll, was often a very sudden one.

Unprecedented Tin-Plate Conditions

The demand for tin plate in 1916 was tremendous. The requirements of domestic consumers were exceptionally large, while there was a heavy export demand, chiefly by reason of the Welsh mills being unable to ship their usual quantities. Early in the war tin plate was made one of the exempted industries, but later the industry was taken from the list and a shortage of labor ensued. Then the British Government began to restrict the tonnage of steel permitted to be given the tin mills, while finally such restrictions were placed upon the exportation of tin plate that it was possible to ship only limited tonnages. Exports of tin plate from the United States and the United Kingdom have been as follows:

Comparison of American and British Exports

	United States, Gross Tons	United Kingdom, Gross Tons		United States, Gross Tons	United Kingdom, Gross Tons
1912....	81,694	481,123	April	21,385	23,337
1913....	57,812	494,497	May	25,585	41,868
1914....	59,549	435,392	June	29,751	30,351
1915....	154,541	368,602	July	18,760	38,174
Jan.,1916	12,178	26,271	Aug.	18,757	34,124
Feb.	13,534	27,289	Sept.	18,770	19,226
March .	20,364	39,482	Oct.	14,177	10,929

The combined exports of the two countries were 9 per cent less in 1914 and 1915 than in 1912 and 1913 and averaged 42,000 tons a month. In the first six months of 1916, however, they averaged 52,000 tons a month, suggesting that the world's requirements had materially increased. With Great Britain's exports greatly decreased, the world must get its tin plate from the United States or do without. Before it does without it will bid very high prices.

Through the long-established practice of making contracts with manufacturing consumers for an entire year the tin-plate mills found themselves well filled with tin-plate contracts for 1916 at $3.50 to $3.60 basis for 100-lb. cokes, the "season price" of $3.60 having been announced Nov. 11, 1915, by the American Sheet & Tin Plate Company. As will be seen by the table already given, the market for prompt lots found itself at $6 in July, this representing a phenomenal advance. The few mills that had not loaded up with contracts made excellent profits, but the mills already sold up suffered a hardship, as the costs of all materials, as well as wages, had advanced sharply. Nor did the end of the year bring them relief, for, in accordance with the usual practice in the sheet and tin-plate trades, the consumers had overbought and the producers had oversold. With the market so high the consumers naturally specified in full, forcing many of the mills to carry over into the new year several weeks, in some instances two months, of low-priced business.

In the circumstances it was but natural that the tin-plate mills should endeavor to strike an average by making a high price for the new season, while at the same time they adopted the more conservative course of selling for only six months. Saturday, Oct. 7, the Phillips Sheet & Tin Plate Company announced its contract price for the first half of 1917 at $6 per base box and the independents immediately adopted this price. On the following Thursday, Oct. 12, the American Sheet & Tin Plate Company created a sensation by announcing a price of $5.75. Some of the independents thereupon receded to $5.75, while others did not. As the mills all predicted a shortage and stated that they would sell only to their regular customers, irrespective of price, no great amount of confusion resulted. By the middle of November the market was higher than $6, while in the latter part of December there were bids by domestic consumers of $7.50 for any delivery in the first half of 1917, while tin plate for export could be sold at $8.

The tin-plate mills operated at practically their full capacity during the entire year and thus were able to produce a tonnage much in excess of the previous record. Our estimate of the 1916 production compares with official statistics for preceding years as follows:

United States Production—Gross Tons

	Tin Plate	Terne Plate	Total
1906.....	491,238	86,324	577,562
1907.....	444,933	69,842	514,775
1908.....	468,257	68,830	537,087
1909.....	526,722	85,237	611,959
1910.....	647,688	75,082	722,770
1911.....	713,227	70,733	783,960
1912.....	877,526	85,445	962,971
1913.....	762,583	61,136	823,719
1914.....	865,975	65,266	931,241
1915.....	982,958	72,978	1,055,936
1916*	1,275,000	75,000	1,350,000

*Estimated.

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The experts do not make an attempt to rate the capacity of a sheet or tin mill, the equipment and other attendant circumstances having an influence, while the character of the specifications has a great influence upon the tonnage. It may be stated as the result of considerable observation that the average sheet mill, operating on average specifications, with two weeks' idleness per year, produces between 4000 and 5000 gross tons annually. The output of tin mills for tin plate varies less, as there is a much narrower range of gages, and the average mill may be taken as having a capacity of 3300 to 3500 tons annually, with two weeks' idleness. Thus it should be possible to make more than 1,500,000 gross tons of tin plate in 1917 without help from new mills. The American Sheet & Tin Plate Company is adding 10 mills at its Shenango works and an equal number at its Farrell works. At Baltimore the Bethlehem Steel Company is building a 24-mill tin-plate plant.

At the close of 1906, 10 years ago, the number of mills was approximately as follows:

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In 10 years the number of mills has increased by about 40 per cent, while the capacity has more than doubled. The output per mill has steadily increased through the mills being made heavier and through various improvements in equipment.

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BY CHARLES LUNDBERG

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After the greatest year in its history, in point of both production and consumption, the copper industry enters 1917 with more metal under contract than ever before. Practically the entire production of the first quarter of 1917 is sold, while it is estimated that the second quarter is over 80 per cent sold. Beyond the second quarter not much has been done.

Foremost among the obligations of the new year is delivery on the record-breaking purchase of the Entente Allies, calling for delivery in the first half of 200,000 gross tons, or 448,000,000 lb., of electrolytic copper, equal to one-third of the production of the period. Deliveries are to be made at the rate of 75,000,000 lb. per lb. a month. In 1914 the Entente powers, including Belgium, took only 182,728 tons of American copper, and in 1913, when a record was established, they took but little more. The total exports in 1915 were 276,344 tons, of which about 250,000 tons went to the Allied governments. For the great quantity to be delivered in the first half of 1917 the average price paid, never officially announced, is understood to have been 25.50c.

The situation is without precedent. There has been nothing like it since 1906 when there was a great buying movement, but near the close of that year electrolytic was quoted at 23.46c. per lb., whereas recently it has been up to 36c. The average price of 1906 was 19.77½c. Broadly stated, first quarter, in the middle of December, 1916, ranged from 35c. to 36c.; second quarter, 33c. to 34c.; third quarter, 32c. to 33c., and fourth quarter at 31c. to 32c. Not since 1873 has the price been so high. In that year it touched 35c. The highest on record was 55c. in 1864. The lowest was 9c. in 1894.

A great impetus was given to buying by the requirements of the munitions makers. The brass mills were busy as never before, and the end of the year found them with increased, instead of diminished, unfilled tonnage. Sheet copper on Jan. 3 was advanced to 29c. per lb. and is now 42c., both being mill prices. In the inception of the war demand there was a mad scramble for copper, but the mills later became more conservative, and bought quietly to cover contracts as the latter were negotiated.

Trade Uneasy Over Prices and Commitments

In the first month of 1916 the trade was uneasy over the extent of its future commitments, and did not want to see prices go much beyond 25c. It was felt that a slump was likely to come, and that it would be proportionate to the height to which prices ascended. Quite recently, with copper at 35c., expression was given to the same sentiment.

On Dec. 12 the trade was stirred by the German peace proposal, which served to bring home the fact that the war might come to a termination sooner than had been believed. The market was rendered quieter, but producers' prices remained practically unimpaired, as well they might in view of the amount of metal under contract. Later in December, second-hands, including some consumers, offered concessions.

The estimated production at present is over 200,000,000 lb. a month, including both Lake and electrolytic, at which approximate point it has been since last September or October. It is figured that by March of this year at least 225,000,000 lb. will be turned out each month. Reliable statistics of the year's production will not be available until later when the figures of the United States Geological Survey are made public. In the years 1909 to 1914 (six months of the latter), in which the monthly statistics of the now defunct Copper Producers' Association were issued, the monthly averages of production of refined copper were as follows, in pounds: 1909, 117,116,921; 1910, 121,010,177; 1911, 119,328,195; 1912, 131,826,690; 1913, 135,204,235; 1914, 139,189,609.

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she thought too high for a necessity of war. In January she fixed £100 as the maximum price of electrolytic, although at the time the London market was £104. She then bought 60,000 tons for her munitions makers. In February the Ministry of Munitions requested consumers to consult with it before paying £100 for any quantity over 50 tons. On March 1 the government forbade dealing in futures. The London Exchange at that time was closed four days, after which business was resumed under restrictions. In December Great Britain made her regulations more drastic, requiring that all holders of copper to give details of their stocks and metal due under contracts. No transactions or negotiations, except under special license, were to be permitted, and, more important than all, the use of copper except for government work was prohibited.

The exports of unwrought copper in 1916 were below those of normal years, but sight must not be lost of the tremendous quantities which went abroad in the form of cartridges and cartridge metal, shell cases, brass and copper rods, tubes, sheets, etc. The American copper-rolling mills have at no time been able to compete with those in England. The exports of unwrought copper in the years 1912 to 1916, in tons of 2240 lb. (eleven months of 1916), were as follows: 1912, 327,965 tons; 1913, 382,810 tons; 1914, 360,229 tons; 1915, 276,344 tons, and 1916, 300,824 tons.

Throughout the year domestic consumers were not without their troubles. They had to contend with transportation difficulties, embargoes, freight congestion, strikes, etc. Some of the Naugatuck Valley mills shut down in February because they could not get metal. Several interests went into the brass business unadvisedly, but they did not get far in a manufacturing way, and in some cases their face was saved only by the extent to which the copper they had purchased and which was resold, appreciated in value. Ordinarily so much resale metal would have upset the market, but its appearance in 1916 created hardly a ripple.

The Course of Tin

A shadow which hung continuously over the market in 1916 was the uncertainty, and often the difficulty, in regard to obtaining licenses to ship from England; yet, despite all the fears, deliveries into United States consumption in 11 months of 1916 amounted to 51,553 tons, against 44,962 tons in the same period of 1915, an increase of 6591 tons. Furthermore, the business of the first 11 months of the year just closed was done at higher average prices than prevailed in 1915.

Twice in the year the record on deliveries into consumption was broken. In February the deliveries totaled 6388 tons, and in June they amounted to 6398 tons. In March, during a temporary scarcity, the price reached 56c. March was a strong month and at no time during it was the price far away from 50c. The lowest level of the year—37c.—was touched in July. Great Britain insisted throughout the year on guarantees from importers, jobbers and manufacturers, designed to keep the metal or manufactured articles containing the metal from the hands of her enemies.

An important accomplishment in the year was the completion of a refinery at the Perth Amboy, N. J., plant of the American Smelting & Refining Company for the smelting and refining of tin from Bolivian concentrates by an electrolytic process. The company announced early in April that it had domestic refined tin for sale which in quality equaled Straits tin. The output of the experimental plant was not large, but the results were so satisfactory that plans have been inaugurated for increasing the output.

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The market for lead was frequently erratic, prices showing a wide variance. The smaller producers often quoted prices far above those of the leading interest, the latter, at such times being apparently willing to let its competitors take all, or most, of the business. War demand caused a runaway market in March, at which time sales were made for export to Japan and Russia at 8c. to 8.12½c., delivered on the Pacific coast. In April, and again in December, the New York price touched 8c. In Chicago, 8.25c. was paid. In March, the American Smelting & Refining Company was quoting 7c., New York, against 8c. asked by independents. The high New York quotation of the year was 8c., in March, April and December, and the low price was 5.50c., at the outset of January.

The exports of domestic lead in 11 months of 1916—80,148 tons—were but little larger than those of the corresponding period of 1915.

Great Production of Spelter

Twice in the year, the views of experts to the effect that the enlargement of capacity for smelting spelter was being greatly overdone was held responsible for declines in prices. When, during these dips, prices reached the bottom there usually followed heavy buying, particularly on the part of galvanizers. It seems to have been demonstrated that galvanizers cannot afford to pay a fancy price for spelter, and in the early part of the year, at least, their operations were at a minimum for want of metal. In July it was figured that none of the galvanizers was operating at more than 50 per cent of capacity, and some at but 35 per cent.

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Quoted at 41c., duty paid, for Asiatic grades (all that were obtainable) in January, antimony mounted to 45c. to 46c. in April. While the demand from the munitions makers was at its height, quotations were strong and the metal was scarce. England controlled the supply from the Far East, and, as with tin, exacted guarantees as to its ultimate consumption. In the last half of the year prices declined for the reason that the use of the metal to harden shrapnel bullets fell off sharply. In August antimony could be had at 9½c., duty paid. The movement of Asiatic antimony to this country has developed into a great trade since the beginning of the war.

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Iron and Steel Prices for Nineteen Years

Monthly Averages Computed from the Weekly Market Quotations of "The Iron Age" in the Period 1898-1916

(With Supplement)

Accompanying this issue of THE IRON AGE is our annual chart, in which lines are plotted to indicate the course of prices for pig iron, Bessemer steel billets and some leading forms of finished iron and steel in the 19 years ended with 1916. The diagrams are based on monthly averages of prices quoted week by week in our market reports from the leading selling centers. The table below, which gives the monthly average prices on which the chart is based, includes also the average prices of No. 2 X foundry pig iron at Philadelphia, which have not been put in graphic form.

Bessemer Pig Iron at Pittsburgh, Dollars per Gross Ton (2240 lb.)

	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916
January	9 87	10.87	24 99	13.15	16 70	22.15	13.91	16 85	18.35	23.15	19 00	17.34	19.90	15 90	15 05	18 15	14 96	14.59	21 58
February	10 05	11 60	24.80	14 43	16 93	21 45	13.66	16 41	18 35	22 85	17.90	16.78	19 34	15 90	14 90	18 15	15 09	14.55	21.51
March	10 39	14 59	24.72	16.31	17.37	21 85	14.25	16 35	18.28	22.85	17.86	16.25	18.60	15 90	15 09	18 15	15.09	14.55	21.75
April	10 41	15 03	24 70	16.75	18.75	21.28	14 18	16.35	18.19	23.35	17.49	15.78	18.27	15.90	15.15	17 90	14.90	14.55	21.95
May	10 30	16.20	21.00	16.30	20.75	20 01	13.60	16.16	18.10	24 01	16.93	15.84	17.52	15.90	15.13	17.70	14.90	14.59	21.95
June	10 34	18.51	19.72	16.00	21.56	19.72	12.81	16.65	18.23	24.27	16 90	16 05	16 60	15.90	15.15	17.14	14 90	14.70	21.95
July	10 25	20.65	16.75	16.00	21.60	18.89	12.40	14 85	18 41	23 55	16.83	16.46	16 40	15.90	15.20	16 70	14.90	14.95	21.95
August	10 35	21.75	15.60	15.75	21.62	18.35	12.81	15 20	19 00	22 90	16 23	17.03	16.09	15.90	15.46	16 52	14.90	15.95	21.95
September	10 78	23 43	13 87	15.75	21.75	17.22	12 63	15 91	19 54	22.90	15 90	18.05	15 90	15 90	16 15	16 65	14.90	16.85	22 26
October	10 36	24 18	13 06	15.89	21.75	16.05	13 10	16 54	20 35	22 00	15 71	19 53	15.90	15.44	17.80	16 60	14.84	16.95	24 08
November	10 15	24.78	13 48	16 00	21.68	15.18	14.85	17 85	22 85	20 65	16.59	19 90	15 82	15 00	18.92	16 02	14.59	17.51	30.15
December	10.58	24.90	13.43	16.31	21.75	14.40	16.65	18.35	23.75	19.34	17.40	19.90	15.90	15.03	18.15	15.77	14.70	19.65	35.58

Bessemer Steel Billets at Pittsburgh, Dollars per Gross Ton

January	14 93	16.62	34.50	19.75	27.50	29 60	23 00	22 75	26 25	29.40	28 00	25.00	27.50	23 00	20 00	28.30	20 13	19.25	32.00
February	15 06	18.00	34.87	20.31	29 37	29 87	23 00	23 50	26 50	29 50	28 00	25 00	27.50	23 00	20 00	28 50	21 00	19 50	33 50
March	15 25	24.30	33.00	22.88	31.25	30 62	23 00	24 00	26.70	29 00	28 00	23 00	27.50	23.00	19 75	28.50	21.00	19.70	42 40
April	15 06	25.37	32.00	24.00	31.50	30 25	23 00	24 00	27 00	30 12	28 00	23 00	26.75	23.00	20 00	28.50	20.80	20.00	45 00
May	14 85	26.75	28.90	24.00	32.20	30 37	23.00	23.50	26.40	30 30	28 00	23 00	26 12	22 60	20 80	27.37	20.00	20 00	45 00
June	14 65	30.10	27.25	24 38	32 37	28 87	23.00	22 00	26 63	29 62	25.75	23.00	25 30	21.00	20 87	26.50	19.50	20.50	43 50
July	14 50	33.12	21 00	24.00	31.75	27.60	23.00	22 00	27 25	30 00	25.00	23.50	25.00	21 00	21.50	26.60	19.00	21.38	41 00
August	15.85	35.40	18.20	24.20	31.06	27.00	23.00	24.00	27.80	29.25	25 00	24.13	24 62	21 00	22.12	26.00	20.25	23.13	44.20
September	16 00	38.87	16.93	24.88	29.50	27.00	20 00	25 00	28.00	29.37	25 00	25 00	24.40	20 75	23 62	24 87	21.00	24.10	45 00
October	15 56	38.75	16 50	26.70	29.70	27.00	19.50	25 62	28.00	28.20	25 00	26.25	23 75	20 00	26.00	23 30	20.00	24 63	46.25
November	15.06	36.50	18.95	27.00	28.50	24 00	20.25	26 00	28.88	28.00	25.00	27.13	23.30	19.50	27.00	21.00	19.25	26.50	52.00
December	15.80	33.75	19.75	27.50	29.12	23.00	21.20	26.00	29.50	28.00	25.00	27.50	23.00	19.25	27.00	20.00	19.00	30.60	57.50

Basic Pig Iron, f.o.b. Mahoning or Shenango Valley Furnace, Dollars per Gross Ton

January	.....	.....	.....	.....	.....	.....	.....	15.46	17.06	21.90	16.90	15.50	16.87	13.25	12.35	16.41	12.50	12.50	17.81
February	.....	.....	.....	.....	.....	.....	.....	15.25	16.82	22.00	15.97	15.12	16.31	13 65	12.25	16.30	13.19	12.50	17.69
March	.....	.....	.....	.....	.....	.....	.....	15.55	16.85	21.50	15.62	14.94	16 00	13.75	12.81	16.11	13 00	12.50	18.20
April	.....	.....	.....	.....	.....	.....	.....	15.06	16.88	21.50	15.25	14.05	15.94	13.75	13 00	15.87	13.00	12.50	18 13
May	.....	.....	.....	.....	.....	.....	.....	15.06	17.00	22.90	14.91	14.12	15.19	13 32	13 00	15.15	13.00	12.50	18.00
June	.....	.....	.....	.....	.....	.....	11.76	14.60	16.94	22.40	15.25	14.62	14.70	13.05	13 12	14.50	13 00	12.59	18 00
July	.....	.....	.....	.....	.....	.....	11.20	14.00	17.12	21 75	14.51	15.05	14.50	13 12	13 40	14 37	13 00	12.74	18 00
August	.....	.....	.....	.....	.....	.....	11.69	14.32	17.70	21.25	14.69	15.25	14.12	13 00	13 94	14 06	13 00	14.06	18 00
September	.....	.....	.....	.....	.....	.....	11.60	14 86	18.44	20 06	14.43	15 90	13.70	12.80	14 37	14 00	13.00	14.75	18 31
October	.....	.....	.....	.....	.....	.....	12.19	15.25	19.55	19.50	14.04	16 94	13.15	12.52	15 98	13 90	12.81	15.00	19.88
November	.....	.....	.....	.....	.....	.....	14.00	16.87	21.37	18.12	14.72	17.25	13.25	12.42	16.37	13 09	12.48	15.75	25.10
December	.....	.....	.....	.....	.....	.....	15.70	16.75	21.50	17.50	15.60	17.05	13.40	12.25	16.50	12.71	12.50	17.50	30.00

Southern No. 2 Foundry Pig Iron at Cincinnati, Dollars per Gross Ton

January	9 50	10.31	20.69	13.45	14.55	21.65	12.37	16.25	16.75	26 00	16.15	16.25	17.25	14.25	13.25	16.95	13.88	12.40	17 90
February	9 25	11 69	20 50	13.12	14.75	21 50	12.12	16 25	16 75	26 00	15.75	16 13	17.06	14.25	13 31	16 69	13.81	12.40	17 90
March	9 25	13 75	20 30	14.00	14.75	21 37	12.10	16.25	16 65	26 00	15 50	15 05	16.30	14 25	13 50	16 31	14 00	12.27	17 90
April	9 25	14 50	20 19	14 50	16 87	20.15	12 50	16.25	16 63	25 06	15 20	14 25	15 37	14 25	13 75	15 65	13.75	12.34	17 90
May	9 37	14 56	19.75	13 85	18.35	18 87	12 25	15 81	16.75	24.25	14 75	14 50	15 00	13 95	14 15	14 94	13.75	12.40	17 90
June	9 30	16 00	18 75	13 37	20 19	17.75	11 80	14 65	16 44	24 10	15 25	14.70	14 85	13 44	14.25	14 06	13 63	12.50	17 34
July	9 25	17 56	16 81	13 00	20 75	16 15	11 81	13 94	16 06	23 85	15 00	15 75	14 75	13 25	14 70	13 75	13 30	12.71	16 90
August	9 37	18 35	14 25	13 00	23 06	15 19	12 00	14 40	17 30	23 00	15 25	16 38	14 31	13 45	15 06	14 06	13 25	13.71	16 70
September	9 55	19 94	13 62	13 06	25 00	14 75	12 00	14 37	18 69	21 50	15 65	17 35	14 25	13 31	15 87	14 25	13 25	14 15	17 28
October	9 75	20 75	12 87	13 75	25 65	13 50	12 81	15 31	20 00	20 95	15 75	17 88	14 25	13 25	16 80	14 35	12 90	14 78	18 03
November	9 75	20 75	12 95	14 00	23 62	12 00	15 19	16 60	23 38	19 50	16 00	17 75	14 25	13 20	17 25	13 87	12 90	16 15	22 40
December	9 90	20 75	13 75	14 25	22 44	12 05	15 85	16 75	25 00	17 00	16 25	17 45	14 25	13 19	17 25	13 95	12 50	17 10	25 90

Local No. 2 Foundry Pig Iron at Chicago (at Furnace), Dollars per Gross Ton

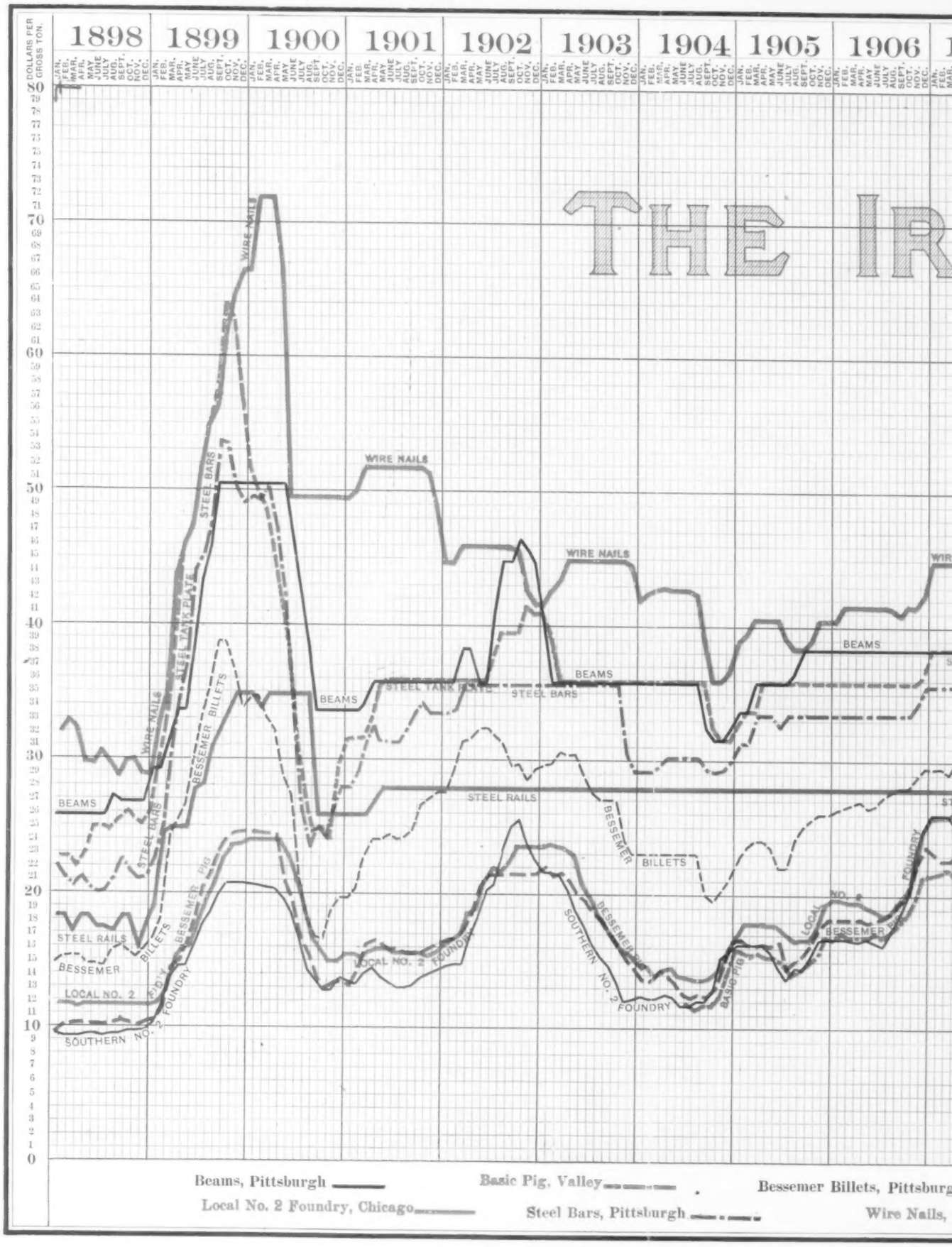
January	11 35	11 47	23 85	15 10	16 25	23 45	14 47	17 85	19 60	25 85	18 45	17 35	19 00	15 50	14 00	17 90	13 75	13 00	18 50
February	11 28	12 47	23 85	14 60	16 85	23 35	13 91	17 85	19 41	25 85	18 16	16 75	19 00	15 50	14 00	17 31	14 00	13 00	18 50
March	11 10	14 95	23 85	15 60	18 51	23 22	14 05	17 80	19 35	26 10	17 85	16 50	18 30	15 50	14 00	17 25	14 25	12 95	18 70
April	11 26	15 47	23 72	15 85	18 97	22 87	14 35	17 60	19 10	26 35	17 73	16 50	17 50	15 00	14 00	17 00	14 25	13 00	19 00
May	11 35	15 72	22 65	15 85	20 85	20 72	13 85	17 60	18 90	26 85	17 63	16 50	17 06	15 00	14 50	16 00	14 06	13 00	19 00
June	11 35	17 95	20 72	15 35	21 85	19 85	13 70	17 00	18 54	26 60	17 73	16 50	16 75	15 00	14 50	15 62	13 69	13 00	19 00
July	11 35	19 22	18 60	15 35	21 60	18 25	13 60	16 47	18 60	25 55	17 55	17 00	16 56	14 87	14 70	14 70	13 75	13 00	19 00
August	11 35	20 65	16 25	15 35	22 10	17 22	13 60	16 60	19 45	24 85	17 35	17 13	16 50	14 50	15 37	15 00	13 69	13 44	18 40
September	11 35	22 22	15 35	15 35	23 35	16 41	13 85	16 60	20 16	24 10	17 05	18 70	16 40	14 50	16 00	15 00	13 25	13 90	18 13
October	11 35	23 35	14 85	15 10	23 35	15 70	14 10	17 66	21 48	22 45	16 85	19 00	16 06	14 46	17 00	15 00	12 94	14 63	19 63
November	11 35	23 45	14 85	15 23	23 35	15 10	15 98	19 15	24 70	20 66	17 10	19 00	16 00	14 09	17 75	14 87	12 56	17 13	25 80
December	11 35	23 85	15 10	15 85	23 35	14 81	16 95	19 60	25 85	18 80	17 35	19 00	16 00	14 00	18 00	14 60	13 00	18 10	29 50

Standard Brands Eastern Pennsylvania No. 2 X Foundry Pig Iron at Philadelphia, Dollars per Gross Ton

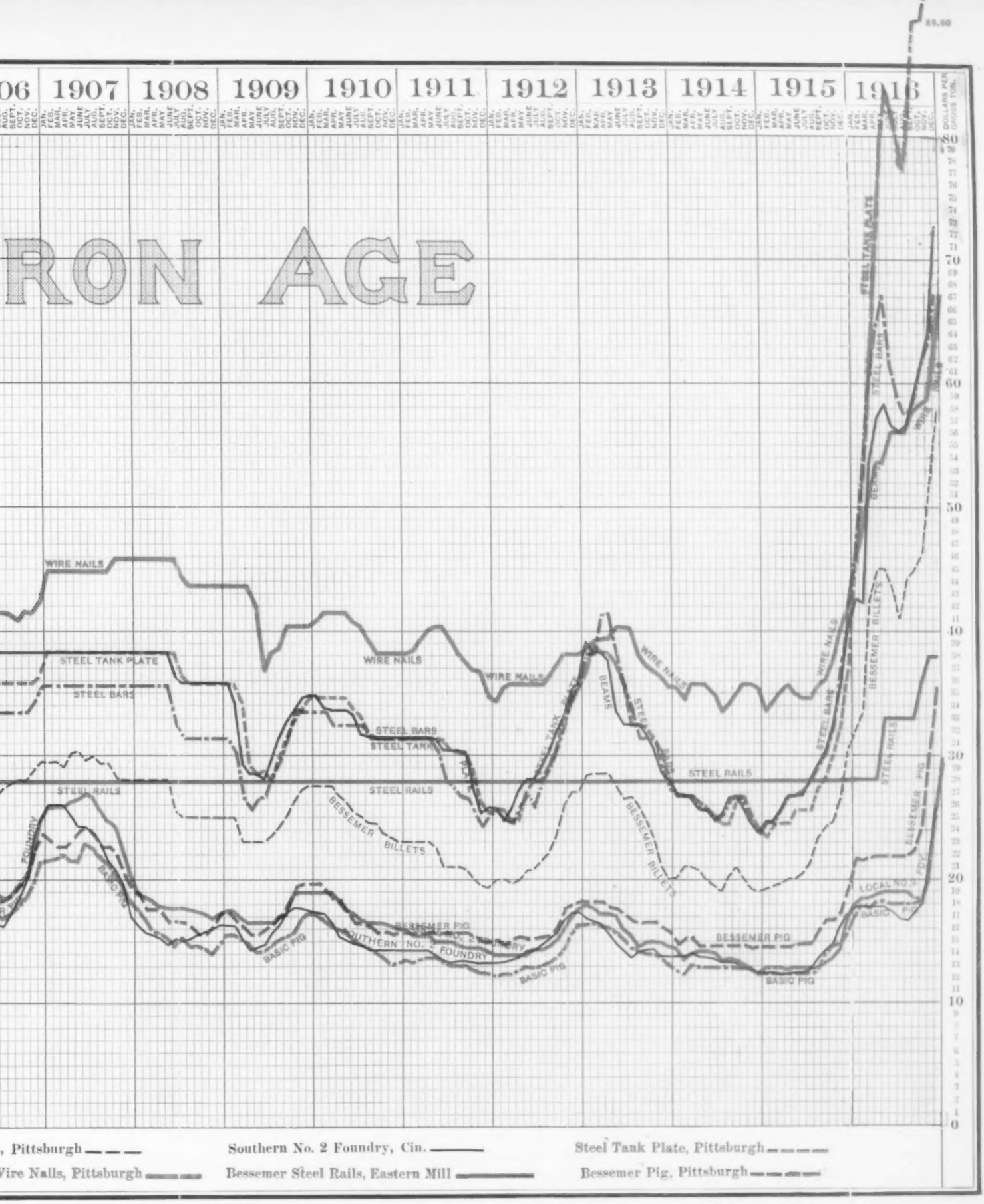
January	10 87	11 44	22.70	15.50	16.75	22.45	14 60	17.50	18.50	24.80	18 25	17 25	19 01	15.50	14 85	18 25	14 65	14 25	19 94
February	10 75	11 06	22.56	15 31	17.19	22.25	14.50	17 50	18.50	25 87	18.25	17 00	18.69	15 50	14 85	18.25	14 94	14.25	20 00
March	10 55	14 70	22 31	15.12	18 81	22.25	14 80	17 56	18 35	25 00	18 12	16 37	18 00	15 50	14 92	17 77	15 00	14 25	20 03
April	10 50	15.75	21.75	15.46	19.62	21.87	15.00	17.75	18.44	24 81	17 65	16 20	17.75	15 50	15.00	17 40	15 00	14 25	20 50
May	10 50	15 81	20 60	15.19	19.75	20.06	14.75	17 81	18 50	25 55	16 94	16 06	17 00	15 50	15 18	16 75	14 81	14 25	20 50
June	10 50	17 25	18.75	15 06	20 94	19.19	14 50	16 75	18 44	24 62	16 62	16 42	16 55	15.25	15 31	16 19	14 75	14 25	19 94
July	10 00	19 44	16 37	15.00	22.30	18.10	14 31	16 12	18 25	23 06	16 50	16 50	16 25	15 00	15 70	15 60	14 75	14 31	19 75
August	10 30	20 65	16 15	14 97	22 00	16 87	14 25	16 25	19 00	21 90	16 50	17 00	16 00	15 00	15 87	15 60	14 75	14 94	19 55
September	10 75	22 75	15 56	14 80	22 00	16 12	14 25	16 43	20 44	20 50	16 62	18 05	16 00	15 00	16 59	15 83	14 75	16 00	19 50
October	10 75	22 75	15 00	15 25	22 12	15 20	14 43	17 25	21 12	19 85	16 75	18 69	15 81	15 00	17 60	15 95	14 63	16 25	20 31
November	10 87	23 40	15 35	15 37	23 37	15 00	15 75	18 05	23 30	18 94	17 00	19 00	15 68	14 95	18 25	15 56	14 50	17 12	24 90
December	11 06	23 25	15 62	15 75	23 00	15 00	16 90	18 25	24 00	18 84	17 25	19 00	15 50	14 85	18 25	15 30	14 25	19 05	29 25

Soft Steel Bars at Pittsburgh, in Cents per Pound

January	0 99	1.02	2.22	1.25	1.50	1.60	1.30	1.40	1.50	1.60	1.60	1.40	1.50	1.40	1.15	1.70	1.20	1.10	2.03
February	0 95	1.12	2 21	1.30	1.51	1.60	1.30	1.40	1.50	1.60	1.60	1.35	1.50	1.40	1.12	1.70	1.20	1.10	2.31
March	0 93	1.36	2.25	1.40	1.60	1.60	1.33	1.50	1.50	1.60	1.60	1.20	1.45	1.40	1.10	1.85	1.20	1.15	2.63
April	0 95	1.56	2.10	1.47	1.60	1.60	1.35	1.50	1.50	1.60	1.60	1.15	1.45	1.40	1.16	1.84	1.15	1.20	2.88
May	0 92	1.67	1.91	1.41	1.60	1.60	1.35	1.50	1.50	1.60	1.60	1.19	1.45	1.37	1.20	1.70	1.14	1.20	3.00
June	0 90	1 98	1.52	1.40	1.60	1.60	1.35	1.46	1.50	1.60	1.45	1.20	1.45	1.25	1.20	1.60	1.11	1.21	2.75
July	0 91	2.02	1.19	1.40	1.60	1.60	1.35	1.50	1.50	1.60	1.40	1.27	1.45	1.23	1.25	1.50	1.12	1.25	2.63
August	0 94	2 14	1.05	1.44	1.60	1.60	1.35	1.50	1.50	1.60	1.40	1.32	1.40	1.20	1.30	1.40	1.19	1.30	2.56
September	1.02	2.40	1.12	1.50	1.60	1.60	1.31	1.50	1.50	1.60	1.40	1.39	1.40	1.19	1.37	1.40	1.20	1.34	2.60
October	0.97	2.39	1.09	1.53	1.60	1.60	1.30	1.50	1.50	1.60	1.40	1.31	1.40	1.12	1.45	1.39	1.15	1.44	2.75
November	0 94	2 24	1.18	1.50	1.60	1.37	1.31	1.50	1.54	1.60	1.40	1.50	1.40	1.08	1.55	1.29	1.10	1.62	2.83
December	0 95	2.20	1.25	1.50	1.60	1.30	1.34	1.50	1.60	1.60	1.40	1.50	1.40	1.12	1.60	1.21	1.07	1.84	3.00



Fluctuations in the Prices of Crude and Finished Iron and



n and Steel from January 1, 1898, to January 1, 1917—Gross Tons

Tank Plates at Pittsburgh, in Cents per Pound

	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916
January	1.00	1.30	2.22	1.40	1.60	1.75	1.60	1.50	1.60	1.70	1.70	1.60	1.55	1.40	1.15	1.75	1.20	1.10	2.25
February	1.00	1.47	2.17	1.40	1.60	1.60	1.60	1.50	1.60	1.70	1.70	1.52	1.55	1.40	1.11	1.71	1.20	1.10	2.56
March	0.97	1.75	2.03	1.47	1.60	1.60	1.60	1.60	1.60	1.70	1.70	1.30	1.55	1.40	1.12	1.70	1.18	1.10	3.10
April	1.02	2.05	1.87	1.57	1.60	1.60	1.60	1.60	1.60	1.70	1.70	1.27	1.55	1.40	1.21	1.68	1.15	1.15	3.56
May	1.10	2.12	1.69	1.60	1.60	1.60	1.60	1.60	1.60	1.70	1.70	1.29	1.51	1.39	1.25	1.60	1.12	1.15	3.75
June.....	1.10	2.32	1.39	1.60	1.69	1.60	1.60	1.60	1.60	1.70	1.62	1.25	1.48	1.35	1.25	1.45	1.10	1.16	3.63
July.....	1.09	2.45	1.16	1.60	1.75	1.60	1.60	1.60	1.60	1.70	1.60	1.36	1.41	1.35	1.30	1.45	1.10	1.22	3.44
August.....	1.12	2.55	1.09	1.60	1.75	1.60	1.60	1.60	1.60	1.70	1.60	1.40	1.40	1.34	1.35	1.44	1.18	1.26	3.70
September....	1.15	2.85	1.11	1.60	1.75	1.60	1.44	1.60	1.60	1.70	1.60	1.46	1.40	1.29	1.47	1.40	1.20	1.34	4.00
October.....	1.12	2.79	1.07	1.60	1.84	1.60	1.40	1.60	1.60	1.70	1.60	1.50	1.40	1.17	1.53	1.36	1.14	1.44	4.00
November....	1.11	2.52	1.31	1.60	1.82	1.60	1.40	1.60	1.62	1.70	1.60	1.54	1.40	1.13	1.59	1.26	1.08	1.65	4.15
December....	1.16	2.30	1.39	1.60	1.82	1.60	1.45	1.60	1.70	1.70	1.60	1.55	1.40	1.15	1.60	1.20	1.05	2.04	4.25

Beams at Pittsburgh, in Cents per Pound

January.....	1.15	1.30	2.25	1.50	1.60	1.80	1.60	1.50	1.70	1.70	1.70	1.60	1.55	1.40	1.15	1.75	1.20	1.10	1.90
February.....	1.15	1.30	2.25	1.50	1.60	1.60	1.60	1.50	1.70	1.70	1.70	1.52	1.51	1.40	1.11	1.71	1.20	1.10	2.06
March.....	1.15	1.40	2.25	1.52	1.70	1.60	1.60	1.60	1.70	1.70	1.70	1.30	1.50	1.40	1.15	1.70	1.19	1.10	2.40
April.....	1.15	1.50	2.25	1.60	1.70	1.60	1.60	1.60	1.70	1.70	1.70	1.27	1.50	1.40	1.21	1.68	1.15	1.20	2.55
May.....	1.15	1.50	2.25	1.60	1.60	1.60	1.60	1.60	1.70	1.70	1.70	1.27	1.50	1.39	1.25	1.50	1.14	1.20	2.60
June.....	1.15	1.70	2.07	1.60	1.60	1.60	1.60	1.60	1.70	1.70	1.62	1.25	1.48	1.35	1.25	1.45	1.11	1.20	2.53
July.....	1.15	1.94	1.90	1.60	1.84	1.60	1.60	1.60	1.70	1.70	1.60	1.33	1.41	1.35	1.30	1.45	1.12	1.25	2.50
August.....	1.21	2.05	1.74	1.60	2.00	1.60	1.60	1.63	1.70	1.70	1.60	1.40	1.40	1.35	1.35	1.45	1.19	1.30	2.52
September....	1.20	2.25	1.50	1.60	2.00	1.60	1.44	1.70	1.70	1.70	1.60	1.46	1.40	1.34	1.42	1.49	1.20	1.35	2.64
October.....	1.20	2.25	1.50	1.60	2.07	1.60	1.40	1.70	1.70	1.70	1.60	1.50	1.40	1.21	1.48	1.37	1.15	1.44	2.75
November....	1.20	2.25	1.50	1.60	2.05	1.60	1.40	1.70	1.70	1.70	1.60	1.54	1.40	1.13	1.57	1.29	1.10	1.60	2.86
December....	1.20	2.25	1.50	1.60	2.00	1.60	1.44	1.70	1.70	1.70	1.60	1.55	1.40	1.15	1.60	1.25	1.07	1.78	3.25

Wire Nails at Pittsburgh, per Keg of 100 lb.

January $1.42	$1.43	$3.20	$2.22	$1.99	$1.89	$1.89	$1.75	$1.85	$2.00	$2.05	$1.95	$1.85	$1.71	$1.57	$1.75	$1.54	$1.54	$2.11
February..... 1.45	1.57	3.20	2.30	2.05	1.92	1.90	1.80	1.85	2.00	2.05	1.95	1.85	1.75	1.60	1.75	1.60	1.57	2.25
March..... 1.43	1.94	3.20	2.30	2.05	2.00	1.91	1.80	1.85	2.00	2.05	1.95	1.85	1.79	1.60	1.76	1.60	1.60	2.40
April..... 1.31	2.05	2.95	2.30	2.05	2.00	1.90	1.80	1.85	2.00	2.05	1.87	1.85	1.80	1.60	1.80	1.60	1.56	2.40
May..... 1.31	2.10	2.20	2.30	2.05	2.00	1.90	1.80	1.85	2.00	2.05	1.65	1.82	1.80	1.60	1.80	1.56	1.55	2.50
June..... 1.35	2.30	2.20	2.30	2.05	2.00	1.90	1.74	1.85	2.00	1.97	1.70	1.80	1.75	1.60	1.80	1.50	1.55	2.50
July..... 1.31	2.42	2.20	2.30	2.05	2.00	1.89	1.70	1.84	2.00	1.95	1.72	1.75	1.70	1.62	1.70	1.52	1.60	2.50
August..... 1.26	2.50	2.20	2.30	2.05	2.00	1.71	1.70	1.82	2.00	1.95	1.80	1.70	1.69	1.66	1.65	1.56	1.61	2.58
September.... 1.32	2.76	2.20	2.30	2.03	2.00	1.60	1.74	1.86	2.05	1.95	1.80	1.70	1.65	1.70	1.65	1.60	1.69	2.60
October..... 1.33	2.87	2.20	2.28	1.89	2.00	1.60	1.80	1.85	2.05	1.95	1.80	1.70	1.64	1.70	1.63	1.60	1.80	2.63
November.... 1.28	2.95	2.20	2.17	1.85	1.97	1.62	1.80	1.88	2.05	1.95	1.80	1.70	1.55	1.70	1.59	1.50	1.87	2.85
December.... 1.27	2.95	2.20	1.99	1.85	1.87	1.73	1.80	2.00	2.05	1.95	1.85	1.70	1.53	1.72	1.55	1.51	2.04	3.00

Brief History of Nineteen Years of Price Fluctuations

In plotting the lines on the accompanying chart, those representing finished material have been derived by multiplying the market prices of finished material per pound by 2240. In the tables, however, while pig-iron and steel billet prices are in dollars per gross ton, those for finished material are stated in the usual way, in cents per pound.

The chart starts with 1898, as that was the year in which the depression following the panic of 1893 showed its most disastrous effects upon iron and steel prices. After the starved consumption of the panic period, demand in 1899 found capacity entirely inadequate. Almost as striking in the other way are the declines of 1900. In 1901 prices were fairly steady, with advances in the latter part of the year bringing another series of high points in 1902, though these are moderate in comparison with 1899. The sharp decline of 1903 is distinctly shown; the slight further decline extending over nine months of 1904, with advances in the latter part of the year; some reaction in 1905, followed by advances in the latter part of the year and a comparatively stable level for the first half of 1906. Then came a strong movement upward, until substantially the levels of 1902 were reached, followed by recessions after the middle of 1907 in pig iron and billets, but finished material prices were held in the weeks following the October panic. The cooperative movement among steel manufacturers modified the decline in the depression of 1908 and in the spring of 1909 came abrupt declines in response to the insistence of some steel manufacturers, particularly of bars, that prices had been kept too high. These cuts stimulated buying which gave the strong upward trend of the second half.

In general, 1910 was a year in which the price movement reversed that of 1909, pig iron reaching again its low points of 1909, while finished materials only retraced part of the distance to the bottom touched after the open market declaration of February, 1909. Steadily declining prices marked 1911. The break in finished material in May, following notice by the Republic Iron & Steel Company that it proposed to reduce its prices, is plainly indicated in the pitch of the curves. There was a slight recovery in December. Early in 1912, however, active competition developed a further decline and the low point for the year was touched in February in some products and in March in others. Gradually rising prices marked the late spring and summer and fall months. The high prices paid for early deliveries were a prime feature of the first four months of 1913. In May prices for early and for future delivery came closer together and by June premiums on prompt steel had practically disappeared. Business fell off as the summer advanced. This was more marked later and in the last four months of the year prices fell off sharply.

In 1914 finished materials gradually drooped as consumption fell off. There was an effort to advance prices in August, under the belief that the war would cause an increased call for American steel; but business continued to fall off, the low prices of the year being reached in December, when many plants operated only about one-third capacity. January, 1915, brought some activity to make up for the extreme depression just preceding. As spring came on war demand for steel increased and export prices advanced. An unparalleled scarcity of steel developed in the late summer and billets advanced rapidly. Plates late in the year went soaring and wire products reached the highest point for 15 years in December. Pig iron lagged until August and then rose, the advance by the end of the year being $5 or $6 a ton.

In 1916 advances in all forms of finished material, due to the enormous demand for shell steel from the Allies and to export demand from all countries, made what were considered high prices in 1915 look cheap. Mills were utterly unable to cope with the business offered, both export and domestic. Pig iron, which for months lagged far behind steel, began advancing in September after heavy sales to Europe, and in November the excited scramble for iron for delivery in 1917 sent prices up by leaps and bounds.

Prices used in plotting the charts are those asked by producers for delivery in from one to three months and thus do not represent the extreme prices paid at times for prompt delivery.

Cast-Iron Pipe Prices—1900 to 1916

The accompanying diagram shows the course of prices for the past 15 years on 6-in. cast-iron water pipe, f.o.b. New York City, in carload lots, per ton of 2000 lb. The table given below is presented for those desiring the data on which the pipe curve is constructed, but going back to 1900. The prices for the first 10 years were furnished by Daniel Runkle, at that time with the Warren Foundry & Machine Company, 11 Broadway, New York, and for the remainder of the period covered were averaged from weekly quotations in THE IRON AGE:

Cast-Iron Pipe Prices at New York, 6-Inch, per Net Ton

	1900	1901	1902	1903	1904	1905	1906	1907	1908
January	$27.50	$21.75	$24.50	$29.25	$24 50	$28.00	$29 75	$34 25	$27.00
February	26.75	22 25	25.00	29 25	24 25	28.50	29 50	34.25	26.75
March	26 75	21.50	26.25	30.75	24.25	26.75	30 50	34 00	26 25
April	26.50	22.00	26 00	31.00	24 25	27.00	29 75	33.50	26 25
May	26 00	22.25	27.75	30.75	24.00	27.25	31.00	34.25	26.25
June	24.50	23.00	28.00	30 75	23.50	27.25	32 50	33.50	25.75
July	24.75	23.75	28.50	30.75	23.50	27.25	30 25	34.00	25.75
August	23 50	23 75	29.50	29.50	23.50	27.75	30.50	32.50	25 25
September	22.25	23.50	29 50	29 00	23 00	27.25	31.00	33 00	25.75
October	21.75	24.00	29.50	26.00	23 25	28 25	33.00	33 50	25 75
November	21 75	24.50	30 75	24.50	25.00	29.00	33.25	28.50	25.00
December	21.75	23.75	29.25	24.25	27 00	29.25	35.50	28.00	25.50

	1909	1910	1911	1912	1913	1914	1915	1916
January	$24.50	$25.50	$22.00	$22.00	$25.00	$22.00	$20.00	$29.00
February	24 25	25.50	21.50	22.00	24.75	22.00	20.00	29.33
March	25 25	25.50	21.00	22.00	23.87	22.00	20.00	29.75
April	25.00	25.50	21.00	21.25	23.50	22.00	21.60	30.5
May	25.25	25 50	21.00	21.00	23.00	20.88	22.00	30.50
June	26 00	25 25	21.00	21.00	23.00	20.50	22.25	30.50
July	26.25	24.00	21.00	22 10	23.00	20.50	22.50	30.50
August	26 00	23.50	21.00	22.00	23.00	20.50	23 25	30.50
September	25.75	23.50	21.00	23.12	23.00	20.40	24 37	30 83
October	25.50	23.00	21.00	24.50	23.00	20.00	25.25	31.50
November	25.87	22.12	21.40	24.12	23.00	20.00	26.50	35.50
December	25.70	22.00	22.00	24.62	22.33	20.00	27.60	41.00

To show how closely cast-iron pipe prices follow the fluctuations in pig iron, we have added to the pipe curve another giving the course of prices on gray forge pig iron at Philadelphia and vicinity, as gray forge is largely used in making pipe. The prices on which this curve is constructed, also going back to 1900, have been averaged from weekly prices in THE IRON AGE, and are as follows:

Gray Forge Pig Iron, Philadelphia and Vicinity, Gross Ton

	1900	1901	1902	1903	1904	1905	1906	1907	1908
January	$20.37	$14.50	$15.75	$21.75	$13.50	$16.25	$16.75	$23.50	$16.50
February	20.25	14.50	15.75	21.25	13.50	15 75	17 00	23.50	16.50
March	19.25	14.00	17.50	20.00	12.75	16.25	16.75	23.50	16.50
April	18.75	14.37	18.25	20.00	13.75	16.25	16 75	23.00	16.00
May	18.00	14 37	19.00	19 50	13 75	16.00	16 50	23.25	16 00
June	16 50	14.37	19 25	18 25	13.50	15.75	16 25	23 00	15.25
July	14.50	14 12	21.75	18.12	13.25	14.50	16 10	22 50	15.25
August	14.50	14.00	21.00	15.50	12.50	15 00	16.50	20.25	15.25
September	14 00	14.00	21.00	14.75	13.00	15.00	17 75	19.50	15 50
October	13.50	14.12	21.00	14.50	12 75	15.75	18.25	18 75	15 50
November	14.00	14.37	22.00	14 00	14 00	16.25	20.00	17.00	15 75
December	14 50	14 87	22 25	14.00	15.50	16.50	22.00	16 75	16 00

	1909	1910	1911	1912	1913	1914	1915	1916
January	$16 25	$17 75	$14 25	$14 25	$17.65	$14.00	$13.50	$18.44
February	16 25	17.50	14.25	14.25	17 31	14.00	13.44	19 00
March	15.50	16.90	14 60	14 25	16.87	14 00	13.25	19.00
April	15.00	16.62	14.75	14 37	16.56	14 00	13.25	19 13
May	15 00	16 00	14.70	14 50	15 81	13.81	13.25	19.50
June	15 25	15 65	14.50	14 62	15.37	13.75	13.25	19 25
July	15.50	15.37	14 50	14.87	14.95	13.75	13 25	18 50
August	16.25	15.00	14.30	15.37	14.62	13.75	14.50	18.50
September	17.00	14.75	14.45	15 87	14.56	13.75	15 13	18 50
October	17.50	14 50	14.25	16 87	15.00	13.62	15 25	19.35
November	18.00	14.37	14.25	17.62	14.75	13.50	16.05	23.75
December	18.00	14.25	14.25	17 75	14.58	13.50	17.63	27 69

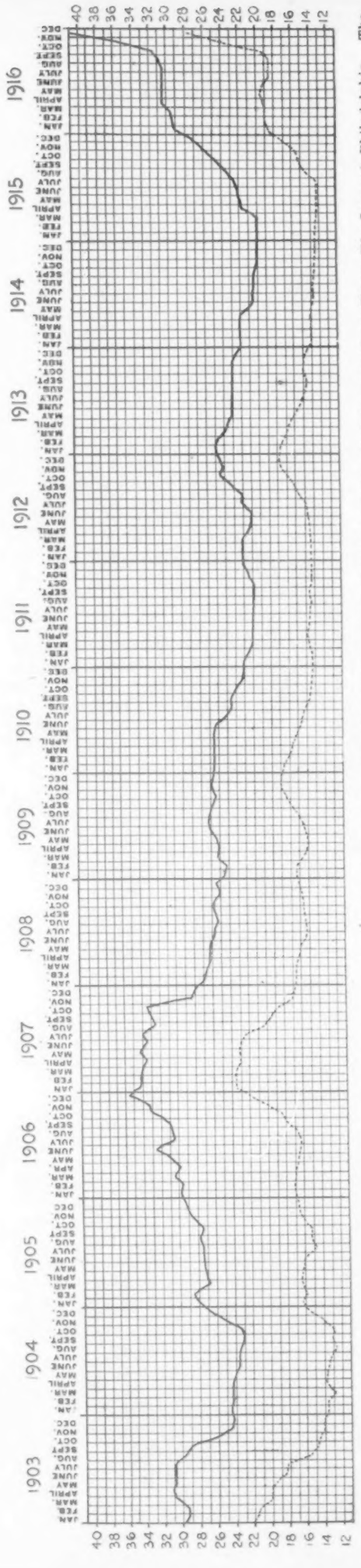


Diagram Showing the Course of Prices of Cast-Iron Water Pipe at New York City for the Past Fourteen Years, Compared with the Course of Prices on Gray Forge Pig Iron at Philadelphia. The Pipe is 6-Inch, Carload Lots, Priced per Ton of 2000 Pounds. The Heavy Black Line Indicates the Pipe Prices and the Dotted Line the Pig-Iron Prices

The coke output of the United States broke all records in 1916, says the U. S. Geological Survey. More than 35,000,000 tons of beehive coke was manufactured, an increase of 27 per cent over 1915, and 19,200,000 tons of by-product coke, an increase of 36 per cent. The total production is estimated at 54,300,000 tons, an increase of 12,700,000 tons.

Connellsville Coke Prices for Sixteen Years

We present below tables showing monthly prices of prompt shipment Connellsville furnace and foundry coke for 16 years, 1901 to 1916, inclusive, averaged from weekly quotations in THE IRON AGE.

Average Prices of Prompt Connellsville Furnace Coke, per Net Ton at Oven

	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916
January	$1.75	$2.90	$5.00	$1.60	$2.46	$2.625	$3.53	$1.92	$1.59	$2.55	$1.40	$1.82	$3.88	$1.85	$1.50	$2.94
February	1.75	2.50	5.00	1.525	2.56	2.14	3.50	1.86	1.59	2.125	1.45	1.78	2.52	1.85	1.50	3.38
March	1.90	2.875	5.00	1.65	2.43	2.24	3.02	1.725	1.60	2.00	1.55	2.125	2.40	1.90	1.50	3.47
April	2.00	2.50	4.20	1.60	2.075	2.45	2.725	1.57	1.60	1.775	1.59	2.39	2.15	1.86	1.50	2.41
May	2.00	2.50	3.50	1.50	1.875	2.46	2.16	1.50	1.575	1.66	1.50	2.28	2.13	1.77	1.50	2.30
June	1.875	2.69	3.00	1.45	1.82	2.325	1.89	1.55	1.525	1.65	1.42	2.02	2.11	1.75	1.56	2.49
July	1.75	3.00	2.50	1.45	1.81	2.51	2.40	1.575	1.58	1.59	1.44	2.21	2.45	1.75	1.64	2.75
August	1.75	3.875	2.25	1.45	1.80	2.76	2.62	1.50	1.66	1.57	1.46	2.21	2.50	1.70	1.50	2.80
September	1.75	5.00	2.20	1.45	2.10	2.85	2.825	1.50	2.39	1.60	1.50	2.375	2.29	1.65	1.61	2.94
October	1.77	8.00	1.90	1.475	2.61	2.84	2.85	1.53	2.76	1.59	1.50	3.41	2.08	1.60	2.03	4.88
November	1.95	6.00	1.75	2.04	2.95	3.13	2.41	1.725	2.74	1.50	1.52	3.94	1.82	1.52	2.28	6.90
December	2.14	6.00	1.625	2.125	2.79	3.525	2.06	1.82	2.67	1.44	1.60	4.00	1.75	1.50	2.64	8.38

Average Prices of Prompt Connellsville Foundry Coke, per Net Ton at Oven

	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916
January	$2.25	$3.17	$6.50	$2.18	$2.38	$3.42	$4.25	$2.45	$2.00	$2.90	$1.90	$1.975	$4.40	$2.50	$2.00	$3.50
February	2.31	3.50	6.50	2.10	2.68	2.65	4.00	2.39	1.95	2.70	2.10	2.09	3.25	2.50	2.00	3.50
March	2.50	3.50	6.50	2.25	2.75	2.78	3.65	2.25	1.95	2.60	2.05	2.56	3.00	2.45	2.00	3.75
April	2.50	3.125	5.50	2.15	2.70	2.95	3.31	2.22	1.86	2.45	2.00	2.69	3.00	2.40	2.00	3.56
May	2.50	3.15	4.50	2.00	2.55	2.81	3.00	2.03	1.85	2.20	1.81	2.58	2.85	2.40	2.00	3.25
June	2.375	2.875	3.50	1.90	2.40	2.65	3.00	2.00	1.80	2.17	1.76	2.40	2.80	2.32	2.00	3.25
July	2.25	3.20	3.25	1.80	2.35	2.79	3.00	2.00	2.00	2.15	1.825	2.40	2.70	2.22	2.05	3.25
August	2.25	4.25	3.00	1.75	2.25	3.00	3.08	1.92	1.95	2.15	1.85	2.40	2.90	2.25	2.00	3.30
September	2.25	6.00	2.875	1.85	2.50	3.19	3.20	1.90	2.55	2.12	1.85	2.54	2.90	2.10	2.07	3.31
October	2.25	9.00	2.875	2.00	3.00	3.31	3.25	2.10	2.90	2.10	1.81	3.65	2.81	2.00	2.35	3.88
November	2.31	7.00	2.50	2.25	3.50	4.00	2.75	2.20	3.25	2.05	1.85	4.25	2.60	1.92	2.88	7.10
December	2.39	7.00	2.25	2.35	3.50	4.125	2.50	2.25	3.20	1.97	1.90	4.50	2.50	1.90	2.95	8.63

Attention should be called to the peculiar conditions prevailing in the coke market in the last half of 1902 and the first half of 1903. In all this period coke prices were seriously affected by the extraordinary demand for coke caused by the scarcity of anthracite coal resulting from the great strike of anthracite coal miners which began in the spring of 1902 and was not settled until late in that year. For several months blast furnaces and foundries were greatly hampered in their operations by inability to secure a regular supply of fuel. Prompt furnace and foundry coke at this time sold as high as $11 per ton at oven, and it is possible that even higher prices may have been realized. Blast furnaces were often banked for a week or two awaiting coke deliveries, and many foundries ran intermittently. Coke was imported to some extent for the use of blast furnaces and foundries located near the seaboard, and foundry coke was shipped all the way to Chicago from Colorado. The quotations which are above given for this period are therefore to be regarded as to some extent conjectural.

Malleable Bessemer Pig-Iron Prices, Chicago

The table below shows monthly prices of malleable Bessemer pig iron at Chicago from 1901 to 1916, inclusive, averaged from weekly quotations in THE IRON AGE, per ton of 2240 lb.

	1901	1902	1903	1904	1905	1906	1907	1908*	1909	1910	1911	1912	1913	1914	1915	1916
January	$15.00	$17.20	$23.24	$14.50	$17.50	$19.37	$26.00	$18.60	$17.09	$19.00	$15.50	$14.35	$17.90	$13.88	$13.00	$19.00
February	14.87	17.75	23.00	14.50	17.50	19.19	26.00	18.25	16.75	19.00	15.50	14.14	17.31	13.94	13.00	19.00
March	15.75	18.50	22.87	14.00	17.50	19.00	26.25	17.50	16.50	18.40	15.50	14.00	17.25	14.25	13.00	19.40
April	16.50	19.50	21.82	14.00	17.50	18.77	26.50	17.50	16.50	17.50	15.25	14.00	17.05	14.25	13.00	19.50
May	15.45	21.80	20.77	14.00	17.37	18.35	26.60	17.56	16.66	17.06	15.00	14.40	16.00	14.06	13.00	19.50
June	16.25	22.00	19.50	13.85	16.65	18.00	26.25	17.37	16.50	16.75	15.00	14.50	15.62	13.88	13.00	19.50
July	16.25	22.75	18.66	13.75	16.37	18.37	25.62	17.50	16.90	16.56	15.00	14.50	14.65	14.00	13.00	19.50
August	16.30	23.00	17.59	13.75	16.50	18.95	24.80	17.50	17.12	16.50	14.80	15.10	15.00	14.00	13.44	19.00
September	16.00	24.00	16.94	13.50	16.56	20.12	24.40	17.26	18.50	16.40	14.50	16.25	15.00	13.25	14.30	19.00
October	15.75	23.90	16.25	13.75	17.37	21.32	22.40	17.00	18.50	16.06	14.50	17.10	15.20	13.00	15.25	19.88
November	15.81	23.87	15.00	15.87	19.00	24.16	20.25	17.00	19.00	16.00	14.35	17.87	14.87	12.88	17.13	25.80
December	17.00	24.00	14.50	16.50	19.50	26.00	18.75	17.00	19.00	16.00	14.35	18.00	14.63	12.90	18.20	29.50

*From this time on the prices are given as at furnace near Chicago, and 35c. to 50c. per ton should be added to get the price delivered to Chicago foundries.

Mahoning and Shenango Foundry Iron Prices

In the following table are presented the monthly average prices of No. 2 foundry pig iron at Valley furnace, namely, at furnaces in the Mahoning Valley, Ohio, and the Shenango Valley, Pennsylvania, from 1901 to 1916, inclusive, averaged from weekly quotations in THE IRON AGE.

	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916
January	$13.20	$15.60	$22.30	$13.00	$16.12	$17.31	$24.60	$16.80	$15.44	$17.00	$13.75	$13.00	$17.50	$12.85	$13.00	$18.50
February	13.16	16.20	21.95	12.47	16.00	17.25	24.12	16.00	15.06	16.69	13.75	13.00	17.00	13.19	13.00	18.31
March	13.97	17.76	22.00	12.91	16.00	17.12	24.00	15.56	14.50	16.10	13.75	13.12	16.69	13.25	13.00	18.50
April	14.10	19.30	20.99	13.01	16.00	16.50	24.00	15.15	14.00	15.62	13.75	13.25	15.55	13.25	12.75	18.50
May	14.10	19.92	20.32	12.47	15.55	16.30	25.00	14.87	14.19	15.31	13.75	13.25	14.62	13.00	12.94	18.20
June	13.66	20.60	19.37	11.96	14.81	16.19	25.12	15.00	14.90	14.75	13.56	13.25	14.06	13.00	12.69	18.12
July	13.20	21.10	18.02	11.67	14.25	16.44	22.80	14.80	15.19	14.31	13.50	13.37	13.87	13.00	12.70	18.25
August	12.97	22.35	16.34	11.87	14.15	17.71	22.50	14.50	15.31	14.15	13.50	13.69	14.00	13.00	13.62	18.25
September	13.10	22.30	14.98	11.71	14.56	19.56	20.87	14.47	15.75	13.75	13.44	14.44	14.00	13.00	14.70	18.39
October	13.60	22.17	14.09	12.50	15.50	21.35	19.80	14.36	17.12	13.94	13.37	16.10	13.84	12.90	14.87	20.00
November	14.41	23.25	13.32	14.60	16.83	23.87	19.00	15.25	17.25	13.90	13.20	16.94	13.50	12.75	15.50	25.00
December	15.20	21.25	13.22	16.19	17.35	24.00	17.37	15.50	17.00	13.75	13.00	17.25	13.50	12.75	18.30	30.75

Philadelphia Scrap Prices, 1896 to 1916

These Prices, Delivered Eastern Pennsylvania, Are Averaged from Weekly Quotations in THE IRON AGE

Heavy Melting Steel Scrap—Per Gross Ton

	1896	1897	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916
Jan.	$13 00	$11 75	$10 19	$11.16	$20.00	$14.90	$18 30	$20 00	$11.56	$17.44	$17.33	$18 61	$11 70	$16 91	$17.00	$12 50	$12 19	$14 40	$10 40	$10.00	$16.38
Feb.	12 75	11 00	10 25	11.50	21.25	15.62	19.00	20 19	12 56	17 37	16.62	18.69	14.25	15 58	16.62	13.50	11 70	12 87	11 00	10 00	16 50
March	12 75	10 94	10 25	13.65	21.90	16 00	20 12	20.75	14.00	17.62	15.80	18.87	13 12	13.50	16.50	14 05	11.80	13 25	11 31	10 80	16 90
April	12 90	10 20	10.19	14 12	21.90	16.75	20.87	20.75	14.69	17.56	16 69	18.75	12 75	13.25	16.12	13 31	12 94	13 44	10 95	11 00	17 88
May	13 00	10 00	10 25	13.56	18.70	16.55	21 00	20.56	12.50	15 94	16 30	18.95	12 81	14.75	14.75	13 00	13 50	12 10	10 63	11 25	16 60
June	13 00	9 81	10.35	14 20	16.00	15.75	20 94	20.50	11.35	14.55	15.75	19 75	13.25	15 81	14.45	13 00	13.50	11 75	10 50	11.10	15.31
July	12 70	10 05	9 75	15.33	11 50	15 81	21 00	19.00	11 12	15.16	15 87	17.62	13.80	15.80	14.12	13.19	13 50	11.35	10 30	12 06	14 94
Aug.	12 50	10 37	9 81	16.40	10.80	16.70	20.50	17.37	11.75	15.55	16.75	16.85	14 50	16.87	13.75	13.15	13 65	11 43	10 19	13 75	14 75
Sept.	12 00	10 75	10 45	18.25	12.56	16.44	20.50	15.87	11 90	15.69	17.94	16.50	15.19	17.40	13.85	12.50	14.50	11 62	10 69	15 00	14 75
Oct.	11 00	10.87	10 44	19.50	12.62	17.50	20 55	13.85	12.87	16 56	18.12	15.35	15.00	18.00	13.81	11.94	15.10	11.15	9 95	14 75	15 63
Nov.	12 62	10 94	10.25	22 00	14.40	17.19	20.50	11.87	14.75	17 55	18.70	12 94	15.75	18.00	13.50	11.55	15.50	10 19	9 25	14 65	20 13
Dec.	12.65	10.25	10.35	20.75	16.75	17.81	20.25	11.25	16.20	17.50	19.50	11.50	17.10	17.50	12.65	12.08	15.25	10.00	9.40	15.81	23.75

Heavy Cast Scrap—Per Gross Ton

Jan.	10 00	9.77	9.25	9.58	17.37	14.50	14.40	19.75	12.75	16.00	16.00	21.70	15.30	15.87	17.00	14.00	13.42	14,50	12 00	12 00	17.00
Feb.	10 00	9 60	9 25	10.91	17 37	14.00	14.81	19.81	12.81	15.62	15 87	22.00	15.00	15 00	16 12	14.38	13 00	14 37	12 88	12 00	17 00
March	10 00	9 57	9 25	11.80	17.15	14.00	16 00	20 00	13.30	15.75	15.50	22.25	15.00	14 00	16 00	14.40	13 12	14 00	13 00	12 00	17 00
April	10 00	9 30	9 25	13.00	16 62	14 00	17.06	20.00	13 37	16 00	15.50	21.25	15 00	14 10	15.87	13 44	13 62	13 91	13.00	11 75	17 88
May	10.00	9 00	9 25	12.75	15.60	13.95	17 70	19.25	12.50	15.19	15.40	20.80	14.87	14 69	15 06	13.13	13 75	13 60	12 25	12 13	17.50
June	10 00	9 00	9 20	13.25	14 00	13.52	18 25	18.37	11.60	14 20	15.37	20.75	14 25	15 00	15.00	13 00	13 75	13 25	12 00	12 25	16 50
July	10 00	9 30	9 00	13.68	13 00	13.62	17.75	17.50	11.25	14.00	15.12	19.25	14.00	14.85	14.94	13 06	13 75	13 00	12 00	12 38	16 00
Aug.	10.00	9 50	9 00	14.25	13 30	13.75	18.25	15.87	11.50	14.40	16.30	18.60	14.25	15.37	14.25	13.20	13.75	12 87	12 00	13 30	16 00
Sept.	10 00	9 50	9 20	15.06	14.37	13.75	19.00	14.75	11.50	15.12	17.44	18.00	15.25	15 90	14.00	12.69	13.96	12.81	12 00	14 00	16 00
Oct.	9 50	9 60	9 25	16.87	13.50	13.75	19.50	13.90	12.37	15.75	18.37	17.60	15.25	16.94	14.00	12.44	14.50	13.50	11 40	14 00	16 15
Nov.	9 75	9 75	9.25	17.90	13.69	14.00	19.50	12.87	13.75	16.00	19.20	16.50	15.44	17 50	14.00	12 25	14.75	12.62	11 00	14.50	18.50
Dec.	10.00	9.35	9.25	17.50	14.12	14.00	19.50	12.50	14.90	16.00	21.12	15.50	16.00	17.50	14.00	13.00	15.00	12.17	11.30	16.06	20.75

Machine Shop Turnings—Per Gross Ton

Jan.	8.00	8.12	7.87	8.58	15.12	9.85	12 95	16.00	8.94	14.50	14.50	16.05	9.00	13.63	14.38	8.12	9 00	11.20	7.30	8 00	11.13
Feb.	8.25	8.00	7.87	8.83	15.25	10.00	13.50	16.00	9.12	15.75	13.81	16 25	9.87	12.00	13.50	9.19	9.25	10.37	9 00	8.00	9 88
March	8.50	8 00	8.00	10.25	15.10	10.89	14.44	16 50	9.45	15.19	13 55	16.75	9 62	10.08	12.80	10 00	8.80	10.12	8 75	8 13	10.25
April	8.30	7 80	8.00	11.00	14 94	12 00	16 37	16 50	10.12	14.75	13 81	16 55	8.40	10.10	11.44	8.87	9.69	10.31	7.90	8.25	11.00
May	8 00	7.50	8.00	11.37	13 90	12.00	16.20	15.75	9.50	13 50	13 19	16.05	9.12	11 62	9 94	8.25	10 40	9 20	7.50	8 44	11.75
June	8.00	7.50	8.00	11.75	10.00	11.56	16 00	15.12	8.20	11.00	12 31	16 94	9.50	12.50	9 65	8.40	10.31	8.00	7 69	8.50	8 63
July	7.80	7.45	8.00	12.50	8.75	11.50	16.50	14.40	7.94	10 66	11.69	15 37	9 80	12.45	9 62	9.00	10.50	7.85	7 75	8.63	8.50
Aug.	7.56	7.25	7.87	12 50	8.20	11 50	16.12	13.00	8.56	12.90	12 65	14 30	10.75	13.50	8.81	9.30	10 65	8 00	7.94	9.80	8.05
Sept.	7.75	7.70	8.00	12.75	8.50	11.56	16.00	11.00	8.75	13.62	13.75	14.00	11.50	14.35	8.75	8.19	10.94	8 00	8.56	10.56	7.44
Oct.	7.75	8.19	8.00	14.00	8.50	11.75	16.00	10.50	9.00	14.25	14.25	12.85	11.80	15.50	8.62	8.00	11.40	7 85	7.90	10.13	10.13
Nov.	8.06	8.19	8.00	15.55	8.85	12.25	16.00	9.75	9.62	14.40	14 85	10.50	12.94	15.06	8.50	8.00	11.50	7.00	7 50	10.25	10.38
Dec.	8.25	8.00	8.10	15.50	9.75	12.75	16.00	9.19	12.50	14.50	15.94	9.00	13.90	14.15	8.15	8.91	11.00	7.08	7.65	11.00	3.38

Cast Borings—Per Gross Ton

Jan.	7.62	7.12	6.87	7.58	13.62	7.94	8.00	10 00	6.50	11.19	11.00	13 55	7.00	12 62	12.22	8.12	8.31	10.85	7.80	8.00	11.50
Feb.	7.75	6.81	6.75	7.83	13.50	8.00	8.00	10.69	7.00	11.25	10.31	14.50	8.37	11.00	11.50	8.81	8.00	10.37	9 19	8 00	11.00
March	8.00	6.75	6.94	9.25	13 60	8.00	8.62	11.12	7.35	11 31	9.85	15 37	7.75	8.17	11 20	9.60	8.50	10 06	8 94	8 00	11.00
April	7.90	6 60	7 00	10 00	13.25	8.37	10.00	11.55	7.56	11 25	10 25	15.69	7.50	8.65	10 38	8.25	9.37	10 25	8 30	8.00	11.38
May	7.75	6 50	7.00	10.37	11.50	8.75	10.05	11.06	6.75	9.87	9.50	16.00	8.12	9 87	9 84	7.75	9 60	9.17	8 00	8.00	12.75
June	7.75	6 50	7.00	10.75	8.25	8.00	10 37	10.31	6.35	8.00	9.37	16.12	8.75	10.50	8.80	7 90	9.50	8.25	8 00	8.10	10.00
July	7.35	6.35	7.00	11.00	7.62	7.81	10.50	9.40	6.12	7.83	9.31	14.37	9.00	10.40	9.50	8.63	9.56	7 85	8.00	8.50	10.00
Aug.	6.75	6.25	6.87	11.00	6.55	7.25	10.12	8.31	6.50	9 20	10 25	13 50	10.00	11.44	9 31	8.80	9 75	7.94	8 50	9.80	9.50
Sept.	6.75	6.60	7.00	11.31	6.69	7.31	10.00	7.50	6.75	9 87	11.25	12.81	11.00	12 45	9.25	7.69	10.06	8.18	8.56	10 44	9 13
Oct.	6.65	7.19	7.00	12.94	6.75	7.50	10.00	7.15	7.11	9.87	11 37	11.20	11.25	13.37	9.06	7.50	10.85	7.90	8 00	10 25	10.10
Nov.	7.18	7.19	7.00	14.25	7.25	7.87	10.19	6 81	7.75	10.60	12.50	8.37	12.00	13.19	8.50	7.50	11.37	7.50	7.50	10 05	11.63
Dec.	7.25	7.00	7.10	14.25	7.75	8.00	10.00	6.44	9.80	10.50	13.00	7.00	12.75	12.10	5.15	8.09	10.83	7.17	7.65	11.00	14.50

No. 1 Railroad Wrought—Per Gross Ton

Jan.	14.00	12.87	12.37	13.16	22.75	18.00	20.00	22 40	15 12	20.75	21.16	22.55	14.30	19.50	19.56	15.63	15.37	16.10	13.05	12 00	22.00
Feb.	14.38	12.75	12.25	13.50	23.00	18.12	21.00	22 87	15 75	21.50	19.87	21.50	15.94	17 75	18.94	16.06	14.00	15.12	14.38	12.00	21.63
March	14.00	12 56	12.25	16 00	23.00	19.50	22 50	23.25	17.20	22.37	19 20	21 12	15.31	15.00	19.00	17.20	14.12	15.25	14 00	12 50	22.13
April	14.00	12.00	12.25	17.50	23.00	19 50	24 37	23.45	17.75	22 50	20 00	20.50	15.00	15 25	18.69	16.06	15.44	15.37	13 25	12.69	23 38
May	14.00	11.50	12.00	17.75	21.60	19.00	23 60	22.50	15 75	18.75	19 20	20 60	15.00	17.12	17 50	15 25	15.75	15.00	12 63	12 94	22.50
June	14 00	11.50	12 00	18.60	16.25	18.12	23 37	20.87	13.00	16 00	17.87	20.75	15.25	18.19	16.70	15.00	15 44	14.75	12 50	13.00	20 50
July	13 20	11.50	12.50	19.50	14.75	17.50	23.00	19.40	12.69	16.16	17 50	19.12	15 95	17.45	16.00	15 13	15.50	13.90	12 20	13.44	19.50
Aug.	12 75	11.50	12.00	19 80	13.70	18.00	23.00	17.50	13.44	18.80	19.70	18.30	17.50	18.87	15 37	15.70	15.80	14.00	12.00	14.95	20.20
Sept.	12.50	12.05	12.00	20.87	14 37	17.87	23.75	17 00	14.45	20.50	21.25	18.00	18.25	19.95	16.10	14.75	16.31	14.68	12.38	16.50	20.00
Oct.	12.70	13 12	12 00	24.37	14.87	18.20	23.70	16.50	15.37	21.62	22.25	17.50	18.30	20.75	16.19	13 94	16 80	14 00	11 80	16.13	21.63
Nov.	13 00	13.12	12.00	26 00	16.50	19.75	22.50	15.25	17.00	22.70	22.25	15.75	19.19	20.75	16.00	13.85	17.06	13 00	11.50	16 50	24.13
Dec.	13.00	12.25	12.10	24.50	17.62	20.00	22.00	14.50	19.10	21.87	23.25	14 62	19.95	19.50	15.90	15.00	16.25	12.75	11.50	20.06	26.75

Old Iron Axles—Per Gross Ton

Jan.	17 00	16.19	15.00	15.16	26.25	20.00	24.20	29.00	15.50	23.12	27.50	31.00	23 00	24.25	28.00	26.00	22.25	26.20	21.00	17.50	27.00
Feb.	17.50	15.69	15.00	15.50	26.00	20.00	24.50	29 25	18.25	23.25	26.50	31 00	23 00	22.00	27.62	26.00	22 00	27.00	23.00	17.50	27.00
March	18.00	14.75	15.00	18.00	26.00	21.50	25.50	30 00	20.10	25.25	24 60	31 00	21.00	18 00	27.60	26.00	22 00	27 00	22.25	17.50	27.00
April	17 60	14 00	15.00	20.75	25.50	22.00	26 25	30 00	21 75	26 00	25 62	30 37	20.00	18.10	28 00	25.00	23 37	26 75	21.00	17 50	28.00
May	17 00	14 00	15 00	21.00	23 00	21.70	27.40	29.00	18.75	24 50	25.50	30.70	20 00	20 75	26 50	24.25	23 00	26 00	20.00	17 50	28.00
June	17.50	12.50	15.00	22.20	17.75	21.50	29 00	26.75	16 80	21.80	25 00	31 12	20 00	22.25	26.50	24 00	23.25	25 50	20 00	17 50	28.00
July	18 00	13.40	15.00	23 00	15.50	21.50	29 00	24 80	17.25	21.33	25 12	29.00	20.80	23.50	26.50	24 25	24.00	25 00	20 00	17.75	28.00
Aug.	18 00	13.50	15.00	24 60	15.00	22.40	29.50	20.62	17.62	24 00	27.40	28.30	22 25	24.00	26.50	24.50	24 00	25 00	20 00	20.60	28.00
Sept.	16.50	13.10	15 00	26.25	15.00	22.00	29.25	20.25	18.10	25.00	29.87	27.50	22.50	26 30	26.50	24.00	24 12	25.00	19 75	22.00	34.25
Oct.	15.60	13.75	15 00	27.75	15.75	23.50	30 00	18 80	19 25	26 12	31.00	27 20	22.50	29 00	26 50	23.50	24 70	25 00	17 8	22 00	35.00
Nov.	16.50	14.75	15 00	32.00	18 80	23.75	29.25	17.50	20.44	27.30	31 30	24.50	23.25	30.00	26.50	21.30	25.75	22 00	17 50	22.00	40 00
Dec.	16.60	15.00	15.00	29.00	20.00	24.00	29.00	15.62	23.10	27.12	32.00	23.00	23.95	30.00	26.50	21.50	26.00	21.00	17.50	25.75	45.00

Old Steel Axles—Per Gross Ton

Jan.	.....	11.00	12.00	12.16	27 25	17.00	19.00	25.00	14.25	20 12	20.62	22 30	18.10	22.50	23.00	19.50	17.25	19 80	15 50	13.38	25.00
Feb.	.....	11.87	12.00	12.68	27.00	17.00	.....	25.25	16.00	20.25	19.87	21.81	18.00	20.50	22.62	20 12	17.00	19 00	16 75	13 50	25.00
March	.....	12.75	12.00	15.15	27.00	17.00	22.00	26.00	17.00	21 25	19.30	22.00	17.62	17.00	22 40	20 80	17.00	19 00	16 25	14.00	25.00
April	.....	12.40	12 00	16.50	27.00	17 00	24.33	26 00	18 00	22 25	20.12	21 62	17.50	17.05	22.00	20.00	17 00	19.00	15 05	14.00	26.00
May	.....	12 37	12 00	16.50	24.20	17 00	25.40	26.00	15 50	19 62	19.60	21.80	17.62	18.75	20.62	19.31	17.00	17.70	14 00	14.00	26 00
June	.....	11.00	12 00	16.60	16 00	17 00	27.00	23.00	15 00	17.30	19.25	21.87	18.00	20.50	20.50	19.25	17.25	17.50	14 00	14.00	26.00
July	.....	11.60	12 00	17.00	16 00	17 00	27.50	21.80	14 75	17.00	18 75	20.50	18.30	21.30	20 12	19.37	17.50	17.50	14 00	14 25	26.00
Aug.	.....	11.75	12 00	17.80	17.70	17.00	26.25	19.50	14 62	20.10	20.75	20.20	19.62	21.87	20.00	19.50	17.50	17.50	14 50	17.60	30 00
Sept.	.....	11.60	12 00	18.75	15.00	17.50	26.00	18.00	15.20	21.00	22.25	20.00	21.25	22.90	20 00	19.00	18 00	18.12	14 81	19.50	34.25
Oct.	.....	12 00	12 00	27 00	15.40	19.00	25 90	16.40	16 25	21 12	23 87	20 00	21.25	23.62	20 00	18 00	18.70	18 10	13 60	19.50	35 00
Nov.	.....	12 00	12 00	30 00	17.00	19.00	25.25	14 50	17.87	21.50	23 30	19.62	21.62	24.00	20.00	17.20	19.75	16.44	13 00	20 70	40 00
Dec.	.....	12.00	12.00	28.00	17.00	19.25	25.00	14.12	18.70	21.50	24.50	18.50	22.20	24.00	19.50	17.25	20.00	15.56	13.00	25.00	45.00

Old Carwheels—Per Gross Ton

Jan.	12.00	10 25	9.37	10.58	20.50	17.00	16.95	20.30	12.87	16 00	18.75	23 00	18.20	16.00	17 50	13.00	12.37	16 20	12.20	11.00	16.38
Feb.	12.25	10 25	9 87	11.58	22.00	16.87	17.00	22 62	13 00	16.00	18.75	23.00	16.62	15.50	16.81	13.44	12.00	15.37	12 63	10.63	16.50
March	12.50	10 00	10 25	14.30	22.00	16.50	17.44	24 50	13.20	16.70	17.70	23.62	15 00	14.00	16.75	14.00	11.94	15 00	12 50	11.00	16.70
April	12 50	9 55	10.25	15.00	22.75	16.75	17.75	24.20	13.50	17 00	16.75	24.00	14.00	14 05	16.06	13.19	12 87	14 87	12.00	11.00	17.38
May	12 43	9 12	10 25	15.00	21.20	17.50	19.50	23.62	12.00	16 00	16.75	24.80	14.00	14 25	15.12	13.00	13.90	13.75	11.75	11.38	16 70
June	12.25	8.81	10 30	15.60	18.00	17.50	19.75	21.87	11 20	14 90	16.69	25 37	13 75	15.00	14.90	13.10	14.00	13 12	11.19	11.55	16 38
July	11.70	8.85	10.00	16 33	18.00	17 50	20 60	21.30	10.75	14.25	16 19	25.00	13.50	15 05	14 25	12.94	14 90	12 30	11 00	12 38	15 63
Aug.	11.50	9.25	9 87	17.30	17 00	16.70	20.00	19.12	11 25	15.20	16.75	23.90	14.75	15.62	13.94	13.00	14.05	12 37	11.25	13.25	15 50
Sept.	11 00	9 25	10.20	19.12	17.50	16.50	20 00	18.25	11 80	15.50	18.37	23.00	15 00	16 80	13.75	12.56	14.25	12.75	11 25	14 00	15 50
Oct.	10.30	9 87	10 25	21.12	15 75	16.20	19 25	16.40	12 37	16.37	20.94	22.40	15.00	17.50	13.75	11.75	14 87	12.46	10 10	13 75	15.88
Nov.	10.43	10.00	10.06	23.20	16.50	16.12	20.50	14.43	13.81	17.10	22.00	19.00	15.62	17.50	13.50	11.35	15.00	12 00	9 50	14 05	18.88
Dec.	10.75	9.25	10.10	21.00	17.00	16.75	20.00	12.75	14.60	18.12	23.00	19.00	16.00	17.50	13.25	12.33	15.50	12.00	10.00	15.63	22.34

Scrap Prices at Chicago, 1903 to 1916

These prices are averaged from weekly quotations in THE IRON AGE

Heavy Melting Steel Scrap, per Gross Ton

	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916
January	$18.05	$10.13	$14.88	$14.95	$16.80	$11.05	$13.94	$16.00	$11.75	$10.75	$12.60	$9.35	$9.19	$15.50
February	18.13	10.88	14.13	13.63	15.75	12.50	13.56	15.50	12.06	10.75	12.13	10.50	9.56	14.75
March	18.31	11.50	14.45	13.00	16.00	11.44	12.13	15.00	12.15	10.94	12.08	9.81	9.63	16.50
April	18.35	11.25	14.38	13.50	15.75	11.05	12.35	14.44	11.75	11.56	12.50	9.80	9.15	16.50
May	17.63	9.75	12.55	13.70	15.60	10.62	13.44	13.56	10.50	12.05	11.25	9.69	9.37	15.94
June	16.50	9.30	11.95	13.13	16.25	11.62	14.50	13.15	10.38	12.12	10.44	9.75	9.44	14.80
July	16.30	9.00	12.75	13.13	16.12	11.75	14.06	12.38	10.69	11.69	10.50	9.75	10.40	14.50
August	16.00	9.25	13.15	14.10	15.10	12.88	15.00	12.25	11.05	12.25	10.56	9.69	11.56	15.25
September	13.75	10.00	14.38	16.50	14.75	13.00	16.00	12.25	10.70	12.81	10.06	9.19	11.75	16.56
October	12.80	10.88	14.50	16.60	14.70	13.45	16.43	12.25	10.00	13.95	10.00	8.50	11.75	16.81
November	11.25	12.55	15.20	17.50	12.63	14.88	16.00	12.25	9.75	13.69	9.56	8.06	13.44	20.60
December	9.00	14.15	15.25	17.13	11.50	15.17	16.00	12.10	10.25	12.88	9.00	8.43	15.63	23.00

Old Steel Rerolling Rails, per Gross Ton

January	$23.50	$11.75	$16.00	$16.50	$19.00	$12.30	$15.81	$18.00	$13.69	$13.00	$16.15	$11.10	$9.62	$17.06
February	23.50	13.13	15.13	16.25	19.0	13.00	15.12	18.00	13.63	12.80	15.50	11.81	9.87	17.06
March	22.13	13.00	15.30	15.70	19.00	12.19	13.06	17.80	13.65	12.75	15.00	11.56	10.25	17.65
April	22.00	13.00	15.44	15.75	18.50	12.60	13.20	17.69	13.44	12.88	14.63	11.50	10.25	18.00
May	22.13	11.88	14.06	16.00	18.60	12.94	14.44	17.12	13.49	13.50	13.95	11.31	10.25	17.38
June	21.00	10.80	12.95	15.88	18.94	13.94	15.50	16.50	12.38	13.50	12.69	11.50	10.25	15.85
July	19.00	10.31	13.56	15.50	18.00	14.50	15.40	15.88	12.25	13.50	12.25	11.50	10.30	15.25
August	19.00	11.50	14.35	15.90	17.00	15.63	16.12	15.31	12.65	14.00	12.12	11.50	12.25	15.80
September	17.33	11.81	15.25	17.63	16.75	16.18	17.15	15.25	12.75	15.00	12.25	10.75	13.35	17.06
October	15.40	12.38	15.63	18.63	17.15	15.80	18.00	15.25	12.44	16.30	12.15	10.00	13.31	18.81
November	13.50	14.75	16.30	21.15	15.06	17.19	18.00	15.06	12.30	16.50	12.00	9.50	14.44	24.50
December	10.60	16.00	16.50	21.00	12.94	16.95	18.00	14.20	12.50	16.50	11.33	9.50	16.63	28.63

Old Iron Rails, per Gross Ton

January	$24.00	$14.00	$21.13	$23.00	$27.40	$15.60	$18.81	$20.00	$15.00	$15.19	$17.05	$13.00	$11.38	$17.50
February	24.00	16.50	20.00	21.75	25.50	17.12	18.25	19.25	15.25	15.25	16.25	13.13	11.63	17.56
March	24.00	16.60	19.60	20.75	25.00	15.44	16.94	19.00	15.35	15.31	16.25	12.94	12.00	17.40
April	23.75	16.88	19.75	20.88	24.88	15.00	16.10	18.50	14.69	15.56	16.19	12.75	11.85	18.00
May	23.75	15.88	18.50	21.25	24.50	14.81	16.63	17.62	14.69	16.25	15.90	12.75	12.39	17.60
June	21.00	14.65	17.15	21.25	24.50	15.50	17.00	17.00	14.38	16.25	14.75	12.75	12.25	18.13
July	19.70	14.13	17.81	21.25	23.75	15.90	17.00	16.75	14.25	16.25	14.00	12.15	12.25	18.50
August	18.50	15.32	19.35	21.90	20.65	16.56	18.38	16.25	14.25	16.30	14.00	12.00	12.25	18.55
September	17.75	16.00	20.88	23.50	20.25	17.35	19.20	16.00	14.50	16.88	14.00	11.70	13.25	19.00
October	17.00	16.69	22.13	26.00	20.05	18.00	20.75	16.00	13.88	17.95	13.90	11.13	13.50	20.44
November	16.25	20.13	22.90	28.00	17.63	18.38	20.62	16.00	14.75	18.25	13.50	11.00	14.94	24.00
December	13.00	22.00	23.00	28.00	15.50	19.50	20.00	15.70	15.00	17.68	13.16	11.00	16.00	28.50

No. 1 Railroad Wrought, per Net Ton

January	$19.50	$10.85	$18.19	$17.30	$16.35	$11.20	$13 81	$14.88	$11.75	$11.63	$12.70	$8.70	$8.69	$15.88
February	19.50	12.50	17.00	15.88	15.50	12.44	12.88	14.69	12.00	11.30	12.19	9 50	8 87	14.94
March	19.75	12.80	16.40	14 88	15.25	11.25	11.43	14.45	12.30	11.44	12.13	9.06	9.00	16.20
April	20.40	12.50	16.06	14.50	15 25	11.00	11.90	14.19	11.69	12.31	12.38	9.00	8 65	17 00
May	19.13	11.38	14.19	14.50	15.45	10.75	12 81	12.87	11.38	12.75	11.25	9.00	8.94	16.50
June	16.13	10.50	13.50	13.50	16 06	11.69	13.38	12.75	11.25	12.57	10.56	9.00	9.00	15.20
July	14.65	10.44	14.13	13.50	15.06	12.15	13.16	12.44	11.00	12.06	10.55	9.00	9.15	14.94
August	14.19	11.13	15.45	14.50	14.40	12.69	14.44	11.94	11.10	12.50	10.62	8.94	10 44	15.30
September	14.06	11 85	16.31	16.13	14.38	13.44	15.35	11.94	10.94	13 13	10.19	8.37	11.00	16.38
October	13.55	12.50	17.00	17.50	14.60	13.60	15.94	11.75	10.44	14.25	9.60	7.87	11.19	17.50
November	12.00	15.44	17.50	18.00	12 32	14.38	15.31	11.94	10.20	13.50	9.00	7.56	12.94	21.00
December	10.00	17.55	18.00	17.25	11.00	14.83	14.75	11.65	10.75	13.06	8.50	7.90	15.38	25.13

Heavy Cast Scrap, per Net Ton

January	$17.30	$10.50	$13.81	$14.70	$17.80	$12.95	$13.06	$14.88	$12.19	$11.25	$12.90	$10.20	$9.19	$13.31
February	16.63	11 38	13 13	13.50	18 25	13.00	12.75	14.88	12.13	11.25	12.69	10 87	9 00	12.81
March	18.13	12.00	13 40	12.75	19.50	12.12	12.19	14.50	12.25	11.31	12.50	10.37	9 00	13.45
April	17.80	11 13	13.81	12.94	18 88	12 05	12.60	13.69	11.81	12.06	12 44	10.25	9 00	12.88
May	16.75	10.25	12.50	13 40	18.55	11 50	13.31	13.13	11.00	12.20	11 60	10 06	9 00	12.56
June	14.63	8.80	12.40	13.50	18.94	12.00	13.81	13 00	10.75	11.81	10 63	9 75	9 00	11 75
July	14.20	8.94	13 38	13 50	18.44	12.15	13.44	13 00	10.50	11.75	10.70	9.65	9 25	11 50
August	14.00	9.88	13 20	14 00	16 75	12.75	14.06	12.75	10.55	12 15	10 87	9.50	9 62	11.50
September	13.00	10.70	13 38	15.38	16.81	12 88	14.75	12.75	10.10	12.81	10 62	9.19	10.10	12.13
October	12.40	10.05	13.63	15 90	16.25	13.25	15.63	12.50	10.25	14.20	10 40	9 00	10 50	13.50
November	11.63	12.69	14.30	17.50	14.00	13.75	15.12	12 50	10 35	13 50	10 06	8.56	12.13	15.55
December	10.50	14.15	15.00	17.50	13 00	13.92	14.75	12.30	11.00	13.25	9.83	9.00	13.75	16.25

Railroad Malleable Scrap, per Net Ton

January	$16.25	$8.25	$14.06	$15.00	$17.20	$10.40	$12 88	$15 00	$10.94	$10.88	$13.40	$9.25	$8.13	$13.81
February	16 25	9.50	13.69	14.25	16 00	11 31	12.38	14.69	10 50	10.30	13 00	10.38	8.09	13.33
March	16.25	10.00	13 44	13 00	16 25	10 60	11.50	14.50	11 00	10.44	13 00	9 56	7 94	13 95
April	16 45	10.00	13 25	13.38	16 38	10 10	11 25	13 69	11 00	11 19	13.19	9 15	8 00	13 89
May	15.88	9.38	12 38	13 50	16 25	9 81	12 38	12.94	10 38	11 55	12 10	9.13	8 14	13.44
June	15 00	8 20	11.90	13.50	17 50	10.25	12 94	12.20	10.10	11.75	11.06	9 00	8 13	11 73
July	15 00	8 25	12 31	13 38	16 75	11 40	12 75	11 25	10 00	11.75	10 60	9 00	8 90	11.63
August	14 50	8 44	13 15	13 60	16 00	12 06	13.69	11 00	10.05	12 05	10 38	8 88	10 00	11.25
September	13 75	9 20	14 19	15 00	16 00	12 38	15 15	11 20	10 00	12.56	10.19	8 25	10 25	11 50
October	13 30	9.88	14.25	15 13	15.20	12.45	15 25	11.00	9 69	13.75	9.65	7.90	10 25	12.38
November	10 25	11.80	14.55	17.30	12 25	13 44	15.13	11.25	9 50	13.56	9.31	7.75	11 38	16.00
December	8.70	13.56	15.00	18.00	10.50	13.70	14.95	11.25	10.06	13.50	9.00	7.95	13.75	18.00

Frogs, Switches and Guards, Cut Apart, per Gross Ton

January	.....	.....	$14.88	$15 00	$17 40	$11.40	$14.00	$16.00	$11.50	$10.50	$12.65	$9.30	$9.19	$15.50
February	.....	.....	14.06	14.75	16.25	12.38	13.56	15.50	11.88	10.50	12.13	10.50	9.86	14.75
March	.....	.....	14.50	13.70	16.50	11 69	12.50	15.00	12.10	10.88	12.13	9.81	9 63	16.50
April	.....	.....	14.25	13 50	16.50	11.50	12.55	14.50	11.63	11.38	12.44	9.90	9.15	16.50
May	.....	.....	13.31	13.70	16.90	11.56	13.44	13.69	10 38	11.80	11.30	9.69	9.38	15.94
June	.....	.....	12.10	13.13	17.25	11.63	14.50	13.15	10.20	11.88	10.44	9.69	9.44	14.63
July	.....	.....	12.75	13.25	16.81	12.30	14.15	12.38	10.44	11.56	10.50	9 75	10.45	14.50
August	.....	.....	13 15	14.30	15.50	14.00	14.88	12.25	10.70	11.95	10.56	9.69	11.56	15 25
September	.....	.....	14.38	16.63	15.50	13.63	15.95	12.25	10.38	12.63	10.19	9.19	11.75	16.06
October	.....	.....	14.50	17.13	15.30	13.85	16.63	12.25	9.94	13.75	10.00	8.75	11.75	16.81
November	.....	$13.25	15.40	18.30	12.69	14.50	16.06	12.25	9.65	13.44	9.56	8.19	13.44	20.95
December	.....	14.38	15.50	18.00	11.63	14.95	16.00	12.10	10.13	12.63	9.00	8.40	15.63	23.25

Old Carwheels, per Gross Ton

January	$24.00	$13.26	$16.56	$19.00	$24.90	$20.10	$15.75	$18.38	$13.00	$13.25	$16.95	$11.65	$9.94	$14.63
February	24.00	14.13	16.38	19.00	23.50	16.94	15.25	17.88	13.00	13.05	16.75	12.44	10.00	13.94
March	24.00	14.50	15.75	18.60	23.88	15.50	14.69	17.00	13.25	13.00	16.75	11.88	9 94	14.30
April	24.00	14.00	15.88	18.75	25 00	14.00	14.50	16.50	13.25	13.25	16.75	11.55	9.75	13.88
May	22.88	13.13	14.81	19 00	25.20	12.88	14.81	15.75	12.75	13.90	15.05	11.50	9.75	12.95
June	21.75	11.20	14.25	18.00	25.38	13.00	15.81	15.50	12.55	14.13	13.94	11.50	10.19	12.44
July	21.50	10.63	14.38	18.00	24.25	13.30	16.00	14.81	12.50	13.88	12.90	11.25	11.30	12.50
August	21.38	11.13	14.95	18.50	24.50	15.50	16.25	14.50	12.85	13.70	12.75	11.25	11.04	11.60
September	20.25	11.10	15.75	19.75	24.50	15.50	18.05	14.00	12.81	14.38	12.63	11.06	11.80	11.69
October	18.00	12.90	16.00	19.31	24.38	15.25	18.31	14.00	12.50	16.00	12.10	10.65	12.00	12.94
November	15.75	14.25	17.10	22.60	23.13	15.50	18.50	13.50	12.10	16.69	12.00	9.81	13.31	17.30
December	13.00	16.25	18.75	25.00	22.00	16.00	18.50	13.50	13.06	16.75	11.88	9.60	14.56	21.25

Foundry Iron Prices, Cincinnati and Chicago

The tables given below show the average monthly prices of No. 2 Southern foundry pig iron at Cincinnati from 1876 to 1916, inclusive, and No. 2 local foundry pig iron at Chicago from 1888 to 1916.

Southern No. 2 Foundry Pig Iron at Cincinnati, per Gross Ton

	1876	1877	1878	1879	1880	1881	1882	1883	1884	1885	1886	1887	1888	1889
January	$22.00	$20.00	$18.00	$17.10	$37.75	$22.50	$25.50	$21.62	$17.25	$15.62	$17.00	$20.12	$18.62	$14.75
February	22.00	20.25	18.00	17.75	41.12	22.50	25.50	21.50	17.00	15.25	17.00	21.00	19.00	14.37
March	22.00	20.40	17.62	18.00	38.12	22.50	24.90	20.60	17.75	14.62	17.00	21.00	18.50	14.50
April	22.00	20.50	17.75	18.00	33.50	22.50	23.50	20.62	17.87	15.15	17.00	21.00	17.75	14.25
May	22.00	20.20	17.00	18.00	26.25	22.25	23.00	20.25	17.25	15.00	16.37	20.50	16.75	14.00
June	20.00	20.25	16.25	17.75	23.25	22.00	22.00	19.50	17.25	15.25	16.12	19.40	15.75	13.68
July	20.00	19.25	16.00	17.75	22.60	21.50	22.25	19.00	16.62	14.81	15.37	19.50	15.50	14.12
August	20.00	18.00	16.20	19.50	24.00	21.50	22.60	18.50	16.00	14.87	15.25	20.00	15.80	14.50
September	19.50	18.00	16.75	25.50	24.00	21.75	22.62	18.50	15.87	15.00	16.75	20.00	16.50	14.50
October	19.50	18.00	17.00	33.50	23.50	22.00	22.37	18.50	16.25	15.00	17.00	19.75	16.50	15.31
November	20.00	18.00	17.00	36.00	22.00	24.50	22.00	18.50	16.18	15.50	17.75	19.50	15.65	16.62
December	20.10	18.00	17.00	35.00	22.25	25.00	22.00	18.37	16.25	16.37	18.60	18.87	15.50	17.56

	1890	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900	1901	1902	1903
January	$18.05	$13.81	$13.75	$12.50	$11.00	$9.25	$11.20	$11.00	$9.50	$10.31	$20.69	$13.45	$14.55	$21.65
February	17.75	13.75	13.62	12.12	10.75	9.25	11.00	9.75	9.25	11.69	20.50	13.12	14.75	21.50
March	16.00	14.00	13.10	12.00	10.20	9.25	10.75	9.69	9.25	13.75	20.30	14.00	14.75	21.37
April	14.31	13.75	13.00	11.75	9.50	9.25	10.40	9.25	9.25	14.50	20.19	14.50	16.87	20.15
May	14.25	14.00	12.81	11.68	9.50	9.50	10.50	8.75	9.37	14.56	19.75	13.85	18.35	18.87
June	14.75	13.75	12.81	11.50	9.61	10.12	10.32	8.75	9.30	16.00	18.75	13.37	20.19	17.75
July	14.75	13.75	12.40	11.37	9.75	11.50	9.75	8.95	9.25	17.56	16.81	13.00	20.75	16.15
August	14.75	13.50	12.17	11.05	9.80	11.50	9.37	9.00	9.37	18.35	14.25	13.00	23.06	15.19
September	14.25	13.50	12.00	10.75	10.00	12.75	9.50	9.35	9.55	19.94	13.62	13.06	25.00	14.75
October	14.25	13.75	12.25	10.75	10.00	12.75	9.95	9.50	9.75	20.75	12.87	13.75	25.65	13.50
November	14.25	14.00	12.50	10.75	9.75	12.75	10.44	9.50	9.75	20.75	12.95	14.00	23.62	12.00
December	14.00	13.75	12.50	10.87	9.25	12.50	10.35	9.50	9.90	20.75	13.75	14.25	22.44	12.05

	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916
January	$12.37	$16.25	$16.75	$26.00	$16.15	$16.25	$17.25	$14.25	$13.25	$16.95	$13.88	$12.40	$17.40
February	12.12	16.25	16.75	26.00	15.75	16.13	17.06	14.25	13.31	16.69	13.81	12.40	17.75
March	12.10	16.25	16.65	26.00	15.50	15.05	16.30	14.25	13.50	16.31	14.00	12.27	17.90
April	12.50	16.25	16.63	25.06	15.20	14.25	15.37	14.25	13.75	15.65	13.80	12.34	17.90
May	12.25	15.81	16.75	24.25	14.75	14.50	15.00	13.95	14.15	14.94	13.75	12.40	17.90
June	11.80	14.65	16.44	24.10	15.25	14.70	14.85	13.44	14.25	14.06	13.37	12.50	17.45
July	11.81	13.94	16.06	23.85	15.00	15.75	14.75	13.25	14.70	13.75	13.30	12.71	16.90
August	12.00	14.40	17.30	23.00	15.25	16.38	14.31	13.45	15.06	14.06	13.25	13.71	16.70
September	12.00	14.37	18.69	21.50	15.65	17.35	14.25	13.31	15.87	14.25	13.25	14.15	17.28
October	12.81	15.31	20.00	20.95	15.75	17.88	14.25	13.25	16.80	14.35	12.90	14.78	18.03
November	15.19	16.60	23.38	19.50	16.00	17.75	14.25	13.20	17.25	13.87	12.90	16.15	22.40
December	15.85	16.75	25.00	17.00	16.25	17.45	14.25	13.19	17.25	13.95	12.50	17.10	25.90

Local No. 2 Foundry Pig Iron at Chicago. (at Furnace after 1907), per Gross Ton

	1888	1889	1890	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900	1901	1902
Jan.	$19.00	$16.00	$19.50	$14.60	$14.50	$13.37	$12.50	$9.75	$13.55	$11.02	$11.35	$11.47	$23.85	$15.10	$16.25
Feb.	18.87	15.00	18.87	15.00	14.37	12.81	11.87	9.75	12.50	11.00	11.28	12.47	23.85	14.60	16.85
Mar.	18.12	15.00	17.62	15.00	14.00	13.00	11.30	9.81	12.00	10.88	11.10	14.95	23.85	15.60	18.51
Apr.	17.50	15.00	16.62	15.12	14.00	13.00	10.50	10.25	12.00	10.75	11.26	15.47	23.72	15.85	18.97
May	17.00	15.00	16.20	15.00	14.00	12.96	10.50	10.25	11.69	10.38	11.35	15.72	22.65	15.85	20.85
June	16.25	14.50	16.00	15.00	14.00	13.00	10.50	10.88	11.50	10.25	11.35	17.95	20.72	15.35	21.85
July	16.00	14.87	16.00	15.15	14.00	12.79	10.12	12.13	11.25	10.25	11.35	19.22	18.60	15.35	21.60
Aug.	16.00	15.10	16.00	15.00	13.75	12.75	10.00	13.20	11.18	10.25	11.35	20.65	16.25	15.35	22.10
Sept.	16.50	15.50	16.00	15.00	13.50	12.75	10.00	13.63	10.75	10.40	11.35	22.22	15.35	15.35	23.35
Oct.	17.12	17.00	16.00	15.00	13.50	12.75	10.00	14.00	10.88	11.00	11.35	23.35	14.85	15.10	23.35
Nov.	17.00	17.62	15.75	14.94	13.50	12.75	9.70	14.00	11.19	11.00	11.35	23.45	14.85	15.23	23.35
Dec.	16.87	18.66	15.37	14.62	13.50	11.69	9.75	14.00	11.25	11.00	11.35	23.85	15.10	15.85	23.35

	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916
Jan.	$23.45	$14.47	$17.85	$19.60	$25.85	$18.45	$17.35	$19.00	$15.50	$14.00	$17.90	$13.80	$13.00	$18.50
Feb.	23.35	13.91	17.85	19.41	25.85	18.16	16.75	19.00	15.50	14.00	17.31	14.00	13.00	18.50
Mar.	23.22	14.05	17.80	19.35	26.10	17.85	16.50	18.30	15.50	14.00	17.25	14.25	12.95	18.70
Apr.	22.87	14.35	17.60	19.10	26.35	17.73	16.50	17.50	15.00	14.00	17.06	14.25	13.00	19.00
May	20.72	13.85	17.60	18.90	26.85	17.63	16.50	17.06	15.00	14.50	16.15	14.06	13.00	19.00
June	19.85	13.70	17.00	18.54	26.60	17.73	16.50	16.75	15.00	14.50	15.63	13.69	13.00	19.00
July	18.25	13.60	16.47	18.60	25.55	17.55	17.00	16.56	14.87	14.70	14.70	13.75	13.00	19.00
Aug.	17.22	13.60	16.60	19.45	24.85	17.35	17.13	16.50	14.50	15.37	15.00	13.69	13.44	18.40
Sept.	16.41	13.85	16.60	20.16	24.10	17.05	18.70	16.40	14.50	16.00	15.00	13.31	13.90	18.13
Oct.	15.70	14.10	17.66	21.48	22.45	16.85	19.00	16.06	14.46	17.00	15.00	12.94	14.63	19.63
Nov.	15.10	15.98	19.15	24.70	20.66	17.10	19.00	16.00	14.09	17.75	14.88	12.56	17.13	25.80
Dec.	14.81	16.95	19.60	25.85	18.80	17.35	19.00	16.00	14.00	18.00	14.50	12.90	18.10	29.50

The Cincinnati prices given above date back to the earliest period for which Southern pig-iron quotations are available at that point. It may be said that these quotations represent almost the beginning of the Northern business in pig iron coming from the vicinity of Birmingham, Ala.

The Chicago prices also represent quotations from the beginning of the production of pig iron in the vicinity of Chicago for the merchant trade. For a long time these prices were quoted delivered on track near Chicago foundries, but beginning in 1908 prices were figured at the furnace, from which at that time a switching charge to local foundries of about 35 cents per ton applied. At the present time the switching charge averages about 50 cents.

Wire Rod Prices at Pittsburgh for Sixteen Years

Quotations on wire rods did not regularly appear in market reports until 1901. The table given below therefore represents the available figures as far back as public prices are concerned. They are for Bessemer wire rods, per gross ton, at Pittsburgh, averaged from weekly quotations in THE IRON AGE.

	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916
January	.....	$33.45	$34.70	$30.00	$31.00	$33.75	$37.00	$34.30	$33.00	$33.00	$28.00	$24.37½	$30.00	$25.50	$25.00	$43.00
February	.....	35.00	35.75	30.00	31 00	34.00	37.00	35.00	33.00	33.00	28.75	25.00	30.00	26.38	25.00	48.00
March	.....	35.50	36.62½	30.80	31.70	34.00	37.00	35.00	33.00	33.00	29 00	25.00	30.00	26 50	25.00	54.80
April	.....	36.00	37.00	31.00	34.00	34.12½	37.00	35.00	29.00	32.50	29.00	25.00	30.00	26 00	25.00	60.00
May	.....	36.80	37.00	30.50	34.00	34.40	37 00	35.00	27.50	32.00	29.00	25 00	30.00	25.50	25.00	60.00
June	.....	37.00	36.62½	29.20	33.30	34.00	37.12½	33.50	27.50	30.80	28.25	25.00	29.50	24.50	25.00	53.75
July	.....	36.00	35.80	28.00	31.87½	34.00	36.50	33.00	29.40	29.25	27.00	25.00	28.30	24 50	25.63	53.75
August	.....	36.00	35.00	28.00	32.10	34.00	36.10	33.25	31.00	28.25	27.00	25.80	28.00	25.00	27.00	55.00
September	.....	35.87½	34.75	27.00	31.12½	34 00	36.00	33.00	31.50	28.00	27.00	27.00	27.37½	26.20	29.40	55.00
October	$32.75	35.90	34.00	26.00	31.75	34.50	35.40	33.00	31.87½	28.50	26.00	28.50	26.60	25.88	31.75	55.00
November	33.00	35.50	31.62½	26.75	32.10	35.50	34.00	33.00	32.50	28.12½	25.30	29.75	25.87½	25.25	36.25	63.00
December	32.62½	34.50	30.50	29.80	32.50	37.00	34.00	33.00	33.00	28.00	24.50	30.00	25.17	25.00	39.50	68.75

L. S. Charcoal Pig-Iron Prices for 28 Years

The following table, which has been compiled from quotations in THE IRON AGE, gives the average monthly prices of Lake Superior charcoal pig iron per gross ton, in carload lots, at Chicago, from 1889 to 1916.

	1889	1890	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900	1901	1902
January	$20.00	$23.00	$18.50	$17.25	$16.50	$15.50	$13.00	$14.50	$13.50	$12.50	$11.50	$25.50	$19.00	$19.25
February	19.50	23.00	18.25	17.00	16.50	15.40	13.00	14.00	13.50	11.50	12.50	25.50	17.50	20.25
March	19.50	22.50	18.00	17.00	16.50	15.25	13.00	13.50	13.50	11.50	15.75	25.50	17.50	20.65
April	19.25	21.50	18.00	16.75	16.50	15.25	12.75	13.50	13.50	11.50	17.00	25.50	18.00	21.50
May	18.75	20.50	17.00	16.50	16.50	15.25	13.00	13.50	13.00	11.50	17.25	24.50	17.50	22.80
June	18.50	20.50	16.75	16.50	16.00	15.25	13.00	13.50	13.00	11.50	19.50	23.00	17.00	23.50
July	18.50	20.00	17.00	16.50	16.00	15.00	13.50	13.50	13.00	11.50	21.50	22.00	17.00	25.00
August	18.50	20.25	17.00	16.50	16.00	14.50	13.50	13.50	13.00	11.50	22.50	20.00	17.00	25.75
September	18.75	20.25	17.25	16.50	16.00	14.25	14.50	13.50	12.50	11.50	24.25	18.50	17.00	26.00
October	19.50	19.75	17.00	16.75	16.00	14.00	15.50	13.50	12.50	11.50	25.00	18.00	17.00	26.00
November	20.00	19.25	17.00	16.50	15.75	13.50	15.50	13.50	12.50	11.50	25.50	17.00	17.50	26.00
December	22.00	18.75	16.75	16.50	15.50	13.00	16.00	13.50	12.50	11.50	25.50	18.25	18.00	25.25

	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916
January	$25.60	$16.62	$18.50	$20.40	$26.80	$22.50	$19.50	$19.50	$17.87	$16.00	$18.15	$15.25	$15.75	$19.50
February	26.50	15.87	18.50	20.13	27.00	21.38	19.50	19.50	17.50	15.95	18.00	15.25	15.75	19.75
March	26.50	15.00	18.50	19.75	26.75	21.25	19.50	19.30	17.50	16.75	18.00	15.25	15.75	19.75
April	25.30	15.19	18.50	19.44	26.50	20.30	19.50	19.00	17.50	15.75	18.00	15.45	15.75	19.75
May	24.12	15.00	17.75	19.05	27.40	20.00	19.50	18.62	17.25	15.75	18.00	15.75	15.75	19.75
June	24.00	14.70	17.00	19.00	27.50	20.00	19.50	18.50	16.80	16.75	16.81	15.75	15.75	19.75
July	22.20	14.50	16.50	19.06	27.00	20.00	19.50	18.50	16.50	16.25	15.65	15.75	15.75	19.75
August	20.62	14.87	16.40	19.35	27.20	19.50	19.50	18.50	16.50	16.25	14.69	15.75	16.00	19.75
September	19.00	14.75	16.87	20.13	27.00	19.50	19.50	18.40	16.50	17.12	15.25	15.75	15.85	19.75
October	18.10	15.31	18.25	21.50	26.20	19.50	19.50	18.12	16.50	18.65	15.25	15.75	15.75	20.25
November	17.12	16.37	19.20	24.63	25.12	19.50	19.50	18.00	16.50	18.65	15.25	15.75	17.00	26.46
December	16.50	17.80	20.00	26.13	24.25	19.50	19.50	18.00	16.37	18.75	15.25	15.75	18.65	31.75

Billet Prices at Pittsburgh for 31 Years

The table below gives the average monthly prices of 4 x 4 in. Bessemer steel billets at Pittsburgh from 1886 to 1916, inclusive. The prices are per gross ton and are averaged from weekly quotations in THE IRON AGE. Prior to 1886 steel billets were not a regular merchant commodity.

	1886	1887	1888	1889	1890	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900
January	$33.00	$24.50	$29.38	$28.15	$36.65	$25.60	$25.00	$21.56	$16.12	$14.90	$16.80	$15.42	$14.93	$16.62	$34.50
February	33.13	35.44	29.38	27.81	35.25	26.00	24.36	21.62	15.75	14.95	17.38	15.25	15.06	18.00	34.87
March	33.00	36.00	29.13	27.25	31.88	26.25	23.00	22.60	15.55	14.84	17.09	15.44	15.25	24.30	33.00
April	32.00	34.75	28.63	27.00	28.38	25.35	22.81	22.44	15.69	15.44	19.53	14.60	15.06	25.37	32.00
May	30.50	32.38	28.35	26.90	27.55	25.50	22.41	21.69	18.00	16.30	19.50	13.82	14.85	26.75	28.90
June	30.75	31.40	28.06	26.75	30.25	25.25	22.97	21.70	18.12	18.63	19.12	14.06	14.65	30.10	27.25
July	30.33	31.50	28.00	27.13	30.70	25.50	23.50	21.06	18.00	20.75	18.85	14.00	14.50	33.12	21.00
August	30.00	32.50	28.40	28.20	30.38	25.31	23.81	20.45	17.15	21.75	18.75	14.00	15.85	35.40	18.20
September	30.50	31.80	29.00	29.50	30.13	25.00	23.65	19.31	17.19	24.00	19.75	15.60	16.00	38.37	16.93
October	31.63	31.63	29.25	33.70	28.70	24.90	23.53	18.06	16.00	21.90	19.75	16.44	15.56	38.75	16.50
November	32.00	31.00	29.00	34.00	27.39	24.16	24.94	17.37	15.57	19.13	20.00	15.57	15.06	36.50	18.95
December	32.90	29.00	28.44	35.60	26.25	24.20	22.40	16.69	15.12	16.97	17.50	15.00	15.80	33.75	19.75

	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916
January	$19.75	$27.50	$29.60	$23.00	$22.75	$26.25	$29.40	$28.00	$25.00	$27.50	$23.00	$20.00	$28.30	$20.13	$19.25	$32.00
February	20.31	29.37	29.87	23.00	23.50	26.50	29.50	28.00	25.00	27.50	23.00	20.00	28.50	21.00	19.50	33.50
March	22.88	31.25	30.62	23.00	24.00	26.70	29.00	28.00	23.00	27.50	23.00	19.75	28.50	21.00	19.70	42.40
April	24.00	31.50	30.25	23.00	24.00	27.00	30.12	28.00	23.00	26.75	23.00	20.00	28.50	20.80	20.00	45.00
May	24.00	32.20	30.37	23.00	23.50	26.40	30.30	28.00	23.00	26.12	22.60	20.80	27.60	20.00	20.00	45.00
June	24.38	32.37	28.87	23.00	22.00	26.63	29.62	25.75	23.00	25.30	21.00	20.87	26.50	19.50	20.50	43.50
July	24.00	31.75	27.60	23.00	22.00	27.25	30.00	25.00	23.50	25.00	21.00	21.50	26.60	19.00	21.38	41.00
August	24.20	31.06	27.00	23.00	24.00	27.80	29.25	25.00	24.13	24.62	21.00	22.12	26.00	20.25	23.13	44.20
September	24.88	29.50	27.00	20.00	25.00	28.00	29.37	25.00	25.00	24.40	20.75	23.62	24.87	21.00	24.10	45.00
October	26.70	29.70	27.00	19.50	25.62	28.00	28.20	25.00	26.25	23.75	20.00	26.00	23.30	20.00	24.63	46.25
November	27.00	28.50	24.00	20.25	26.00	28.88	28.00	25.00	27.13	23.30	19.50	27.00	21.00	19.25	26.50	52.00
December	27.50	29.12	23.00	21.20	26.00	29.50	28.00	25.00	27.50	23.00	19.25	27.00	20.00	19.00	30.25	...

Prices of Galvanized Sheets from 1898 to 1916

The table below gives the monthly average prices, f.o.b. Pittsburgh, in cents per pound, of galvanized sheets, as quoted in THE IRON AGE from the beginning of 1898 down to the present month. It was the custom, in marketing galvanized sheets, up to a comparatively recent period, to observe the usage in the hardware trade of maintaining a standard list for the several gages, and, in making prices, to name a discount from this list. It was therefore necessary, in compiling the greater part of this table, to convert discounts into net prices.

Average Prices of No. 28 Galvanized Sheets, at Pittsburgh, in Cents per Pound

	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916
January	3.12	3.08	3.83	4.36	4.64	3.70	3.36	3.35	3.45	3.67	3.59	3.55	3.50	3.20	2.90	3.46	2.87	2.79	4.75
February	3.06	3.62	4.09	4.36	4.36	3.70	3.25	3.40	3.45	3.75	3.55	3.51	3.50	3.20	2.87	3.50	2.95	3.16	4.75
March	3.15	4.17	4.32	4.84	4.36	3.78	3.23	3.45	3.43	3.75	3.55	3.26	3.50	3.20	2.80	3.50	2.95	3.40	4.75
April	3.10	4.25	4.78	4.84	4.36	3.89	3.23	3.45	3.40	3.75	3.55	3.25	3.50	3.20	2.86	3.50	2.91	3.29	5.00
May	3.06	4.25	4.66	4.74	4.36	3.88	3.23	3.45	3.40	3.75	3.55	3.25	3.50	3.20	2.90	3.42	2.80	3.50	4.94
June	3.06	4.52	4.59	4.59	4.23	3.81	3.18	3.35	3.55	3.75	3.55	3.25	3.50	3.00	2.90	3.38	2.75	4.28	4.69
July	3.06	4.72	4.53	4.48	4.26	3.73	3.14	3.36	3.55	3.75	3.55	3.25	3.39	3.00	3.00	3.33	2.75	4.40	4.88
August	3.10	4.85	4.43	4.74	4.18	3.66	3.14	3.32	3.55	3.75	3.55	3.25	3.30	2.99	3.12	3.24	2.85	3.71	4.21
September	3.15	4.59	4.33	4.73	3.99	3.66	3.14	3.30	3.55	3.75	3.55	3.28	3.21	2.93	3.21	3.16	2.95	3.56	4.18
October	3.15	4.53	4.25	4.55	3.87	3.73	3.14	3.30	3.58	3.75	3.55	3.35	3.20	2.85	3.36	3.08	2.95	3.50	4.41
November	3.06	4.21	4.16	4.84	3.85	3.51	3.23	3.32	3.65	3.75	3.55	3.43	3.20	2.85	3.40	2.98	2.88	3.89	5.18
December	3.06	3.88	4.36	4.84	3.78	3.40	3.31	3.35	3.65	3.75	3.55	3.50	3.19	2.89	3.40	2.90	2.78	4.75	6.00

The highest prices realized for galvanized sheets were obtained in April of this year, following the spectacular performances of spelter, when prices of that metal soared to an unprecedented height. At that time, No. 28 galvanized sheets sold up to 5.30c. per lb., Pittsburgh, or higher, although the average for the month is placed, in the table, at 5c. It is interesting to know that in 1901, in a period of great activity in the steel trade, No. 28 galvanized sheets were regularly quoted at 5.10c., Pittsburgh, for two weeks, namely, the first half of September. The lowest price realized, as shown by the table, was 2.75c., Pittsburgh, which price ruled in June and July, 1914. The price did not run below 3c., Pittsburgh, in the years covered in this table until 1911, although in 1893 it dipped close to that level.

Metal, Tin-Plate and Sheet Prices for Nineteen Years

Monthly Averages Computed from the Weekly Market Quotations of "The Iron Age" in the Period of 1898-1916

(With Supplement)

The accompanying supplement shows by plotted lines the fluctuations in prices of the more important metals, tin plate and sheets in the period from 1898 to 1916, inclusive. The prices used for this purpose are the computed monthly averages of the prices of carloads, at New York, for metals and at Pittsburgh for tin plate and No. 28 galvanized and black sheets, given in the metal market reports of THE IRON AGE week by week. The columns of figures alongside the chart give the values. The column nearest the chart gives tin in cents per pound; the middle column, copper and spelter in cents per pound, and the outside column represents lead and sheets in cents per pound and tin plate in dollars per base box. The following tables give the monthly averages on which the chart is based, except for galvanized sheets, the table for which will be found on page 19:

Lake Copper, at New York, in Cents per Pound

	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916
Jan.	11.00	14.02	16.21	16.90	11.45	12.13	12.62	15.18	18.78	24.41	13.90	14.56	14.00	12.81	14.50	16.98	14.85	14.02	24.39
Feb.	11.19	17.66	16.25	16.97	12.47	12.80	12.34	15.25	17.94	25.10	13.13	13.37	13.78	12.75	14.41	15.55	15.00	15.21	26.85
March	11.95	17.55	16.41	17.00	12.12	14.31	12.60	15.25	18.50	23.38	12.85	12.90	13.75	12.58	14.88	15.05	14.79	15.75	27.16
April	12.05	18.56	17.00	17.00	11.97	14.85	13.19	15.18	18.62	24.62	13.09	12.94	13.31	12.41	16.00	15.67	14.75	18.90	28.27
May	12.04	18.65	16.80	17.00	12.10	14.75	13.28	15.00	18.70	24.10	12.88	13.21	13.06	12.33	16.30	15.91	14.40	21.00	28.88
June	11.85	18.20	16.31	17.00	12.23	14.56	12.74	15.00	18.69	23.94	13.00	13.50	12.88	12.71	17.53	15.42	14.12	22.38	27.83
July	11.59	18.37	16.31	16.97	11.94	13.73	12.62	15.03	18.47	21.95	13.00	13.34	12.66	12.78	17.54	14.78	13.70	21.98	25.84
Aug.	11.85	18.50	16.55	16.50	11.59	13.35	12.50	16.67	18.65	18.94	13.71	13.56	12.93	12.75	17.73	15.86	12.86	19.33	26.95
Sept.	13.25	18.47	16.75	16.50	11.60	13.58	12.67	16.12	19.31	16.41	13.80	13.50	12.81	12.65	17.77	16.77	12.66	17.97	28.03
Oct.	12.37	18.03	16.73	16.71	11.71	13.42	13.09	16.62	21.81	13.80	13.81	13.19	12.84	12.53	17.80	16.85	11.73	17.89	28.48
Nov.	12.69	17.00	16.75	16.82	11.44	13.25	14.22	16.90	22.50	13.94	14.44	13.44	12.98	12.80	17.70	16.16	12.00	18.92	32.32
Dec.	12.79	16.69	16.87	14.71	11.61	12.30	14.87	18.75	23.06	13.48	14.53	13.80	13.00	13.84	17.69	14.88	13.35	20.24	33.38

Spelter, at New York, in Cents per Pound

Jan.	3.75	4.90	4.55	4.08	4.28	4.82	4.95	6.17	6.43	6.90	4.54	5.15	6.26	5.55	6.52	7.15	5.29	6.59	18.19
Feb.	3.79	5.68	4.69	3.94	4.18	5.00	4.95	6.12	6.09	7.00	4.78	4.99	5.89	5.56	6.71	6.45	5.40	8.84	20.13
March	4.00	5.99	4.60	3.89	4.29	5.36	5.05	6.06	5.96	6.92	4.76	4.81	5.72	5.65	6.98	6.26	5.28	9.29	18.40
April	4.00	6.25	4.71	3.94	4.41	5.65	5.22	5.97	6.05	6.81	4.68	4.94	5.60	5.51	6.86	5.77	5.18	11.23	18.58
May	3.95	6.72	4.52	3.97	4.50	5.75	5.14	5.55	5.95	6.51	4.60	5.12	5.20	5.50	6.86	5.47	5.06	16.14	15.86
June	4.65	6.02	4.27	3.95	4.88	6.00	4.79	5.32	6.14	6.45	4.56	5.39	5.19	5.63	6.99	5.18	5.09	22.18	12.75
July	4.51	5.79	4.24	3.90	5.23	5.95	4.85	5.38	5.98	6.15	4.46	5.35	5.20	5.79	7.26	5.38	5.02	20.58	9.83
Aug.	4.35	5.55	4.17	3.92	5.46	5.94	4.85	5.66	6.06	5.71	4.71	5.74	5.26	6.04	7.19	5.75	5.60	14.11	8.98
Sept.	4.62	5.40	4.10	4.02	5.45	6.00	5.06	5.53	6.19	5.28	4.76	5.85	5.53	6.03	7.53	5.82	5.50	14.16	8.22
Oct.	4.61	5.37	4.10	4.20	5.48	6.05	5.17	6.05	6.18	5.45	4.81	6.09	5.69	6.20	7.57	5.42	4.97	13.96	9.98
Nov.	5.09	4.64	4.20	4.32	5.29	5.68	5.49	6.17	6.36	5.10	5.03	6.32	5.95	6.60	7.48	5.29	5.12	17.15	11.90
Dec.	5.13	4.68	4.19	4.35	4.91	5.15	5.80	6.50	6.62	4.39	5.17	6.35	5.80	6.44	7.33	5.18	5.71	16.69	11.13

Lead, at New York, in Cents per Pound

Jan.	3.66	4.02	4.70	4.37	4.02	4.10	4.39	4.56	5.86	6.30	3.73	4.19	4.70	4.50	4.41	4.35	4.11	3.74	5.93
Feb.	3.69	4.53	4.70	4.37	4.10	4.10	4.40	4.50	5.56	6.31	3.75	4.07	4.63	4.46	4.00	4.35	4.06	3.82	6.23
March	3.71	4.37	4.70	4.37	4.10	4.44	4.50	4.45	5.35	6.31	3.88	4.02	4.51	4.41	4.08	4.35	3.97	4.04	7.43
April	3.61	4.30	4.70	4.37	4.10	4.59	4.50	4.50	5.39	6.16	4.02	4.19	4.40	4.44	4.20	4.40	3.82	4.20	7.73
May	3.64	4.42	4.22	4.37	4.10	4.37	4.48	4.50	5.90	6.02	4.26	4.32	4.37	4.40	4.20	4.37	3.90	4.25	7.45
June	3.86	4.45	3.90	4.37	4.10	4.25	4.22	4.51	5.94	5.75	4.45	4.36	4.33	4.46	4.50	4.35	3.90	5.89	6.87
July	3.95	4.55	4.03	4.37	4.10	4.12	4.17	4.56	5.80	5.24	4.50	4.35	4.40	4.50	4.67	4.37	3.90	5.59	6.34
Aug.	3.99	4.56	4.26	4.37	4.10	4.12	4.15	4.64	5.78	5.12	4.59	4.36	4.40	4.50	4.54	4.64	3.87	4.68	6.26
Sept.	3.99	4.60	4.36	4.37	4.10	4.26	4.20	4.85	5.92	4.84	4.54	4.39	4.40	4.49	5.04	4.73	3.86	4.62	6.88
Oct.	3.81	4.59	4.37	4.37	4.10	4.40	4.20	5.07	5.94	4.64	4.34	4.39	4.40	4.31	5.06	4.52	3.52	4.60	7.00
Nov.	3.70	4.58	4.37	4.37	4.10	4.25	4.51	5.48	5.97	4.45	4.39	4.40	4.44	4.31	4.66	4.33	3.68	5.16	7.13
Dec.	3.62	4.65	4.37	4.19	4.10	4.19	4.60	5.96	6.19	3.76	4.24	4.56	4.50	4.45	4.32	4.06	3.80	5.33	7.69

Tin, at New York, in Cents per Pound

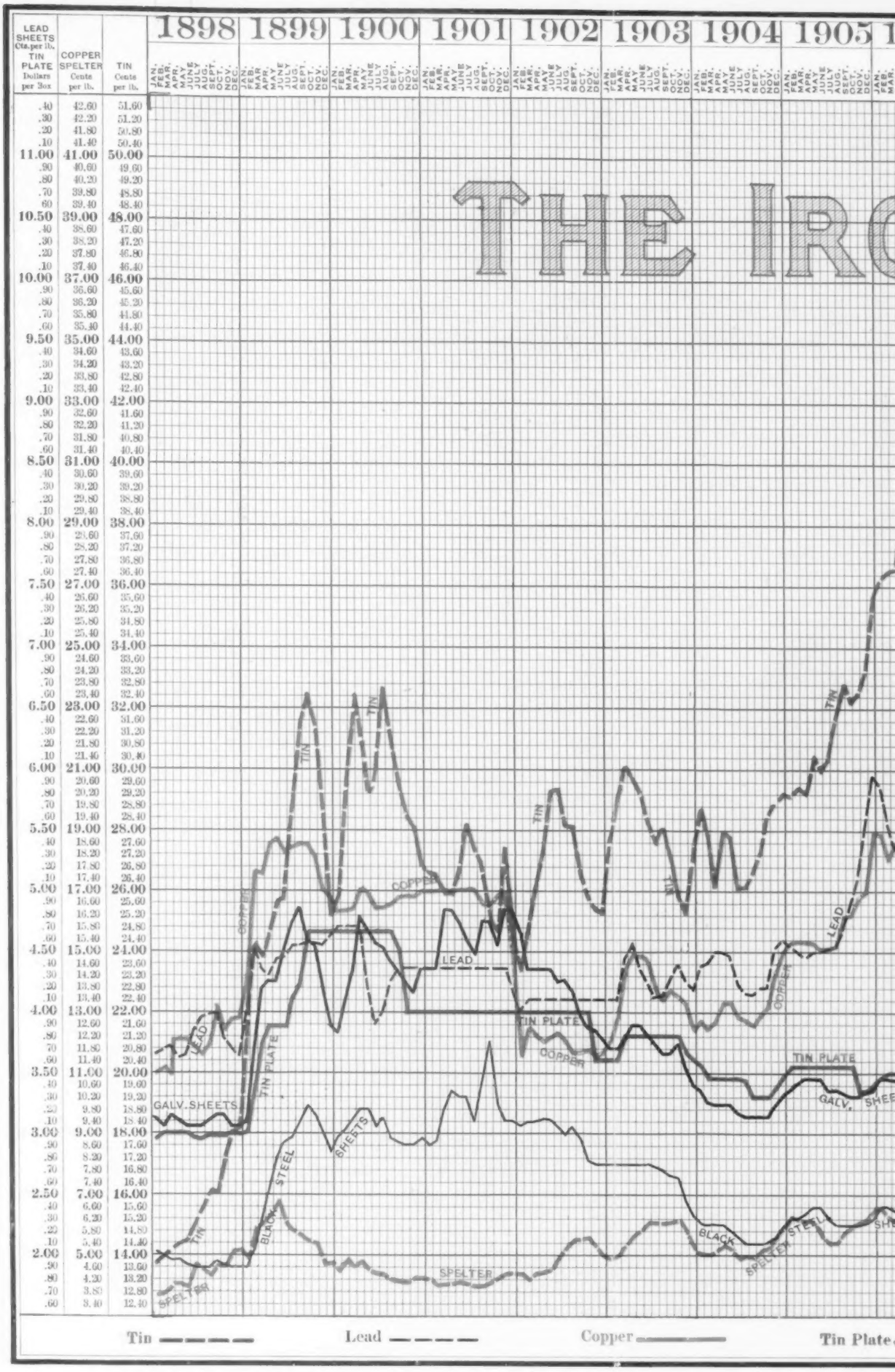
Jan.	13.77	22.12	26.60	26.60	23.38	27.76	28.75	29.18	35.36	42.14	27.43	28.19	32.61	41.20	44.58	50.34	39.12	34.13	41.76
Feb.	14.04	24.25	29.71	26.55	24.73	29.14	27.98	29.49	36.48	42.16	28.74	28.44	32.65	43.34	43.56	48.71	39.82	37.25	42.60
March	14.26	23.86	32.42	25.95	26.16	30.06	26.19	29.21	36.62	41.29	30.46	28.75	32.51	41.10	42.76	46.93	38.03	48.73	50.53
April	14.41	24.82	30.85	25.94	27.29	29.69	27.99	30.43	38.86	40.84	31.79	29.35	32.83	42.05	43.64	49.04	36.10	47.64	51.51
May	14.54	25.61	29.25	26.82	29.26	29.36	27.76	30.04	43.08	43.01	29.84	29.07	33.05	43.32	45.98	49.06	33.21	38.79	49.14
June	15.05	25.69	30.00	28.22	29.29	28.30	26.14	30.36	38.97	42.65	28.18	29.26	32.79	46.25	47.44	45.01	30.60	40.26	42.07
July	15.60	28.72	32.76	27.41	28.28	27.60	26.28	31.71	37.18	41.15	28.92	29.05	32.99	43.23	44.70	41.32	35.65	37.38	38.25
Aug.	16.14	31.40	31.13	26.90	28.14	28.00	26.74	32.85	39.90	37.35	29.99	29.96	33.92	43.38	45.86	41.63	48.34	34.37	38.88
Sept.	16.02	32.40	29.63	25.04	26.55	27.06	27.27	32.21	40.32	37.22	28.91	30.00	35.17	39.69	49.16	42.63	31.13	33.13	38.65
Oct.	17.25	31.35	28.46	24.62	25.76	25.53	28.53	32.47	42.90	32.33	29.44	30.41	36.76	41.23	50.07	40.38	30.25	33.05	41.10
Nov.	18.07	28.52	28.10	27.47	25.43	25.35	29.00	33.46	42.70	30.81	30.43	30.74	37.38	43.08	49.87	39.75	33.28	39.50	44.12
Dec.	18.20	25.19	26.84	24.39	25.33	27.53	29.27	35.84	42.62	27.92	29.13	32.91	38.21	45.03	49.86	37.12	34.01	38.53	42.66

Tin Plate, at Pittsburgh, in Dollars per Box

Jan.	$2.95	$3.00	$4.65	$4.00	$4.00	$3.60	$3.56	$3.55	$3.47	$3.90	$3.74	$3.70	$3.60	$3.60	$3.40	$3.60	$3.32	$3.10	$3.75
Feb.	2.90	3.38	4.65	4.00	4.00	3.60	3.45	3.55	3.50	3.90	3.70	3.70	3.60	3.67	3.35	3.60	3.29	3.10	3.96
March	3.00	3.75	4.65	4.00	4.00	3.80	3.45	3.55	3.50	3.90	3.70	3.53	3.60	3.70	3.30	3.60	3.30	3.25	4.19
April	3.00	3.87	4.65	4.00	4.00	3.80	3.45	3.55	3.57	3.90	3.70	3.40	3.60	3.70	3.30	3.60	3.30	3.25	4.50
May	3.00	3.87	4.65	4.00	4.00	3.80	3.45	3.55	3.66	3.90	3.70	3.40	3.60	3.70	3.33	3.60	3.30	3.15	5.30
June	2.99	3.87	4.65	4.00	4.00	3.80	3.45	3.55	3.75	3.90	3.70	3.40	3.60	3.70	3.40	3.60	3.30	3.11	5.81
July	2.94	4.12	4.65	4.00	4.00	3.80	3.41	3.55	3.75	3.90	3.70	3.40	3.60	3.70	3.43	3.60	3.27	3.10	6.00
Aug.	2.93	4.23	4.65	4.00	4.00	3.80	3.30	3.55	3.75	3.90	3.70	3.40	3.60	3.70	3.50	3.55	3.41	3.10	5.95
Sept.	2.98	4.65	4.50	4.00	4.00	3.80	3.30	3.55	3.75	3.90	3.70	3.40	3.60	3.67	3.58	3.50	3.35	3.15	5.75
Oct.	2.98	4.65	4.00	4.00	4.00	3.80	3.30	3.34	3.75	3.90	3.70	3.50	3.60	3.52	3.60	3.50	3.24	3.15	5.81
Nov.	2.98	4.65	4.00	4.00	3.60	3.65	3.39	3.34	3.90	3.90	3.70	3.56	3.60	3.40	3.60	3.40	3.15	3.28	5.97
Dec.	3.00	4.65	4.00	4.00	3.60	3.60	3.47	3.40	3.90	3.90	3.70	3.60	3.60	3.40	3.60	3.40	3.13	3.52	6.63

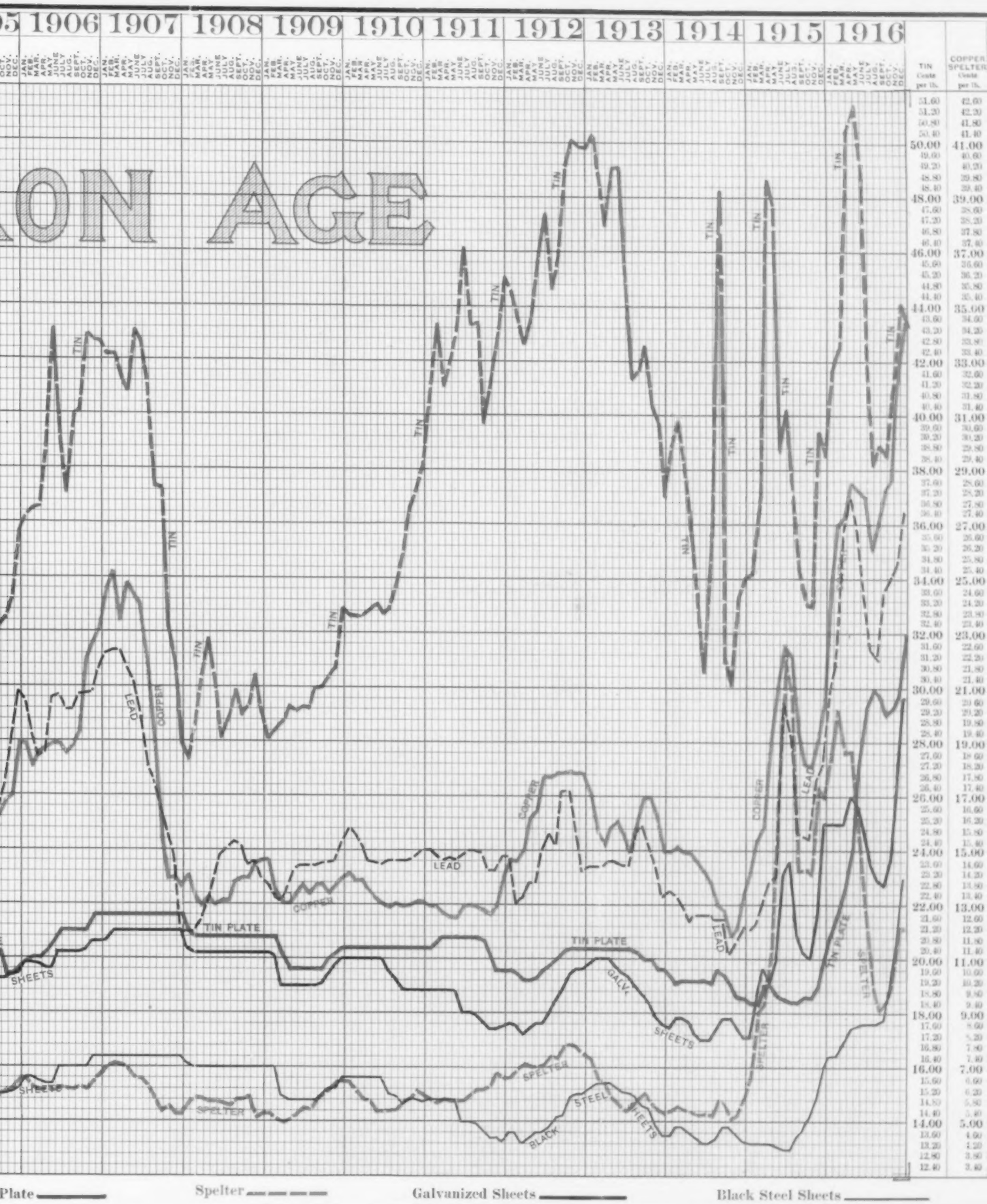
No. 28 Black Sheets, at Pittsburgh, in Cents per Pound

Jan.	2 02½	1 92½	2 97½	2 90	3 07½	2.75	2.29	2.30	2.40	2.60	2.52	2.50	2.40	2.20	1.90	2.31	1.87	1.80	2.60
Feb.	2 00	2 05	3 03	2 93¾	3.10	2.75	2.27½	2.30	2.40	2.60	2.50	2.50	2.40	2.20	1.87	2.35	1.95	1.80	2.60
March	1 96	2 36	3 10	3 22½	3.10	2.75	2.27	2.34	2.38	2.60	2.50	2.25	2.40	2.20	1.80	2.35	1.95	1.80	2.71
April	1 97½	2 60	3 20	3.35	3 12½	2.75	2.25	2.40	2.35	2.60	2.50	2.20	2.40	2.20	1.86	2.35	1.91	1.80	2.85
May	1 92½	2 78¾	3 20	3.30	3.10	2.75	2.20	2.40	2.35	2.60	2.50	2.20	2.40	2.20	1.90	2.30	1.85	1.79	2.89
June	1 90	2 93	3 05	3.30	3.05	2.75	2.16	2.30	2.50	2.60	2.50	2.20	2.40	2.00	1.90	2.27	1.81	1.75	2.90
July	1 90	2 97½	3 14¾	3 10	3.00	2.73¾	2.10	2.26	2.50	2.60	2.50	2.20	2.23¾	2.00	1.95	2.25	1.80	1.75	2.90
Aug.	1 90	3 08	2 98	3.41	3 05	2.70	2.10	2.26	2.50	2.60	2.50	2.20	2.21	1.99	2.02	2.21	1.86	1.85	2.90
Sept.	1 96	3 22½	2 93¾	3 77½	2 97½	2.65	2.10	2.25	2.50	2.60	2.50	2.26	2.15	1.91	2.07	2.14	1.95	1.90	2.93
Oct.	1 92	3 15	2 90	3 23	2.79	2.62	2.10	2.25	2.50	2.60	2.50	2.30	2.20	1.85	2.21	2.04	1.94	2.03	3.23
Nov.	1.90	3 00	2 89	3.10	2.75	2.49	2.12½	2.27	2.60	2.60	2.50	2.30	2.20	1.85	2.25	1.97	1.87	2.25	3.65
Dec.	1.90	2.87½	2.96	3.10	2.75	2.32	2.22	2.30	2.60	2.60	2.50	2.40	2.19	1.83½	2.25	1.89	1.83	2.50	4.31



Fluctuations in Carload Prices of Lake Copper, Lead, Tin and S
Pittsburgh from

NOTE—To enable the great advances in prices of copper and spelter in 1915 and 1916 to be completely sho
is less t



d Spelter in New York and Tin Plate and No. 28 Black and Galvanized Sheets
om January 1, 1898, to January 1, 1917

ly shown in this diagram, it has been found necessary to plot the prices of these metals on a special scale, and hence the sharpness in the cu
less than in the case of the other products

Metals and Alloys in the Steel Industry

A Review of Conditions in 1916—Tungsten Still the Feature—Cobalt and Uranium—Ferrosilicon Situation More Acute

BY DE COURCY BROWNE*

DE COURCY BROWNE

THE year 1916 opened with prices of all metals and alloys far above normal, but as the year progressed and especially toward the end, prices of all steel ingredients rose violently with the exception of tungsten and manganese, and on account of the enormous October buying movement to supply the new steel plants with raw materials, practically all available supplies of metals were taken out of the market, and December saw prices at the highest.

There was no striking metallurgical advancement in the year, nor special demand for anything new in metals and alloys. Several new metallurgical plants were put in operation, the principal one using Mississippi power at Keokuk, Iowa, for the manufacture of 50 per cent silicon. Also an electric-furnace plant on the Pacific coast started on ferromanganese, but this could hardly be considered a new proposition because it had already operated a number of years on other products, mainly pig iron.

The capacities of nearly all metallurgical plants were enlarged to supply the ever-growing needs of the steel makers, but the quality of products was not in any way sacrificed for these increased outputs. Metals and alloys which are produced in this country to-day are fully equivalent to if not the superior of the foreign products we were accustomed to use before the war. We are never told that domestic alloys are inferior to foreign products, which in itself is a source of pride, for before the war foreigners set the pace on practically all special products used in the steel business. This includes manganese, silicon, tungsten, chrome and molybdenum, the only exception in the more important metals being vanadium.

As may be supposed, exports have been prohibited by European countries on practically all metals in the past year, the notable exception in the case of Great Britain being manganese. Although small items have drifted in from time to time, there was generally some special arrangement with foreign consumers to ship back the finished product in which they were to be used. Early in the year England shipped fairly large quantities of tungsten here to be used in the manufacture of tool steel, which was either shipped back abroad or used in machining shrapnel for the allied countries.

There is no shortage of necessary ores, although some prices are very high. This refers particularly to chrome ore which now comes mainly from New Caledonia, the American sources of ore having proved very disappointing.

Due to the intricacies of the business, practically no new concerns have entered the field as competitors. Established manufacturers have been able to increase their capacities to meet the growing demands, although the shortage of electric power at Niagara Falls, principally on account of Canadian restrictions, has lately complicated the situation.

Electrolytic Ferrosilicon

The year 1916 opened with 50 per cent electric-furnace ferrosilicon in only fair demand. Consumers had all contracted for their supplies and producers seemed to have very little difficulty in keeping up deliveries. Regular quotations in January called for $83 to $85 per gross ton, Pittsburgh, and there was no apparent change from this figure until October, when it was announced that on account of greatly increased cost of apparatus entering into the production of silicon, the price would be $95 to $100 for 1917. However, some 1917 material was taken below these figures. The cost of electrical equipment, including transformers and electrodes, has advanced so rapidly that it is difficult to see just what the end will be. This product is also influenced by the price of scrap.

With steadily increasing open-hearth capacity, the consumption of ferrosilicon has grown greatly and two or three times as much being used now as before the war. Munition steels which run fairly high in silicon require large quantities of this alloy. Such steel is largely made in basic furnaces, and 50 per cent ferrosilicon is used mainly on account of the addition being made in the ladle, whereas in acid steels high silicon pig iron is generally used to supply the necessary silicon content and the addition is made in the furnace just before tapping. The 50 per cent alloy is also used in almost all Bessemer and electric steels. While a great many new electric furnaces have been installed, the new production of electric steels from a tonnage standpoint is not of great consequence.

Toward the end of 1916 the power situation at Niagara Falls became very acute, and it would not be surprising if there is a great shortage of ferrosilicon in the early part of 1917.

A fair quantity of 75 per cent ferrosilicon is consumed largely in the manufacture of steel containing high silicon, such as electrical steels with about 4 per cent silicon. A 90 per cent ferrosilicon is also used somewhat for the same purpose, but the cost is much higher in proportion than for the lower grades.

Ferromanganese

Wide fluctuation occurred in the value of this metal in the past year, although final quotations were only about 25 per cent higher than in January. The year opened with English ferromanganese about $125 at seaboard, and at that time there was a decided shortage on account of the difficult shipping situation. The English alloy was rapidly advancing and $225 was obtained on urgent orders, although $150 had been the contract quotation for 1916 material, but no guarantee of delivery could be obtained from the manufacturers. Toward the end of March the shortage was more acute and buyers were very nervous about their sources of supply. A few carloads were sold as high as $400 to $500 per ton, although the nominal quotation was then about $175 seaboard.

About a month later, several large cargoes came

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Cuban Manganese Ore

from abroad so that the situation was very much relieved. The price then gradually eased off until July. The market then settled at about $175 to $200, seaboard. Since that time it has been rather stable, but at present is only fairly firm at $165 to $170.

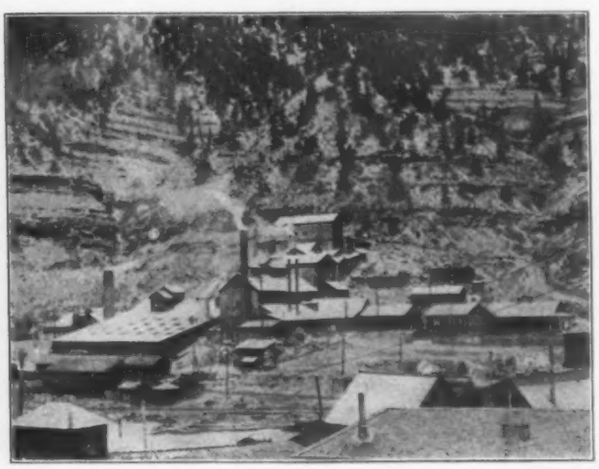
Several of the large steel companies are now manufacturing this alloy for themselves as well as for the outside trade, and several old blast-furnace stacks have been renovated and put on ferromanganese. American producers are entirely dependent on ores from South America, Cuba and the Orient, our American ores having been very disappointing as far as tonnage is concerned. Some high-grade ores in limited quantities have come in from Japan.

The domestic production of ferromanganese is increasing rapidly. October output was over 21,000 tons. The imports of manganese ore into the United States during the last few months of 1916 were greater than corresponding imports into Great Britain. This situation has never existed before and is of more than passing interest.

A higher grade of manganese is manufactured by the Goldschmidt process which is known as pure carbon-free material, but it is not largely used in steel making. Its main application is for non-ferrous work, although in flour form it is used to harden the surface of steel castings by being applied to the hot mold in a liquid state.

Vanadium

The production and uses of vanadium have advanced during the past year. Export shipments have increased materially, being now at the rate of about 400,000 lb. contained vanadium yearly as against about 300,000 lb. for 1915. The increase will undoubtedly continue, as foreign governments, particularly Russia, are very largely specifying vanadium steel parts in locomotive construction.



Typical Mill for Treating Colorado Vanadium Ores

Vanadium is used principally in high speed and other cutting tool steels, automobile steels and steel castings which must withstand heavy dynamic stresses, and the production of these items has been enormously increased since the war began. The price has not advanced in proportion to those of other alloys and throughout the year has been between $2.25 and $3 per lb. of contained vanadium.

It is to be noted that practically the entire world's supply of vanadium is manufactured in America from Peruvian and Colorado ores and this raw material has not been interfered with since the war began. There seems to be an abundance of available ore and it is apparently only a question of increasing the capacity of existing reduction plants to supply the growing demand.

The market value of vanadium is influenced more particularly by the fluctuations of metallic aluminum than by any other element, since practically all high-grade ferrovanadium is manufactured by the Thermit process in which aluminum is the principal reagent.

Ferrotitanium

With a steady growth in the use of titanium in the past year, prices have not advanced materially. The present scarcity and high price of aluminum have been of assistance in establishing titanium as a very widely used deoxidizer in the steel industry. The price of 60c. per lb. makes aluminum practically prohibitive for this work. As the shortage of 50 per cent ferrosilicon becomes apparent, the demand for titanium should be favorably influenced.

Electric furnace titanium is quoted to-day at about the same price as early in the year, but the cost of Thermit titanium has advanced somewhat. There are only two producers of this alloy—one manufacturing a high-carbon product and the other manufacturing the carbon-free grade. The ore used for both grades comes from domestic sources and the supply is apparently ample to cover the demand.

It is reported that considerable titanium has been shipped abroad for foreign consumption, although in previous years little if any had been exported.

Ferrochromium

The use of chromium has increased perhaps in a greater ratio than that of any other component of alloy steels, since it allows the steel to be extremely responsive to heat treatment. It is an easy alloy to introduce, and is not difficult to manipulate in steel melting. It is used in practically all grades of special steels including high speed, automobile, locomotive and magnet steels, and also to a large extent in cast-steel rolls. During the past year it has been substituted for tungsten in magnet steels and a very satisfactory magnet has been obtained. This has been of great assistance to the automobile manufacturers, as the high price of tungsten was becoming a very serious problem.

High-carbon ferrochromium is produced in the electric furnace and the carbon-free grade by the Thermit process. There has been a great scarcity of chromium ores, which are largely imported from Turkey, New Caledonia and Russia, and this, together with the ever-increasing cost of electric-furnace equipment and aluminum, has caused the price of both grades of ferrochromium to advance considerably.

For a time it appeared as if domestic ores would solve the problem, but faith in our own supply was badly misplaced. The production of American chrome ores has been practically negligible as compared with the supplies from elsewhere. Canada should furnish a fair

share of this ore, but on account of various government restrictions very little has come in.

The highest grade of chromium is known as the pure carbon-free, which contains about 99 per cent chromium. This is not used extensively in steel making, but has a wide application in the manufacture of special materials.

Cobalt and Uranium

Cobalt metal is used to obtain a superior grade of high-speed tool steel, and is also one of the components of stellite, a non-ferrous alloy which under certain conditions is superior to high-speed tool steel. The consumption of cobalt has just about held its own during the past year. As a matter of fact, a good grade of high-speed steel can be made without cobalt, and it does not seem as if this extra alloy were an essential element on account of the comparatively large extra cost of its use. The price has gradually advanced from $1.75 per lb. to $2.25 per lb.

Uranium is being widely advertised by several manufacturers of high-speed tool steel and some reports from the trade would indicate that it has certain merits, but up to the present writing its use has hardly passed the experimental stage, and it is not possible to make any very definite statements pertaining to uranium at the present moment.

Tungsten

The year 1916 opened with tungsten very steady at about $6 to $6.50 per lb., but the market gained strength in February and rose to $8.50 to $9.50 per lb., which prices held until June. The demand at this point considerably exceeded the supply. Toward the end of June, large quantities of tungsten concentrates appeared on the market, and the price of the metal and alloy began to drop violently. In fact, there was no market at all for tungsten, for the reason that all buyers had fully contracted and they were not justified in buying at a concession.

In July the market found itself at $2.75 per lb., but eased off gradually during August, September and October to about $2.60 per lb. In the last two months of the year, there being no visible stocks of ore on the market, the metal advanced and there seems to be a fair and steady demand up to about $2.75 per lb. for the powdered metal, although some ferrotungsten is offered below this figure.

Metallurgically there should be no particular advantage in the powder over the alloy. It is a matter of individual preference; but there seems to be more ferrotungsten available than powder, and undoubtedly for this reason the former is offered at a concession. Some very inferior ferrotungsten has been manufactured in this country because the reduction furnace in general use is of the "knock-down" variety, which does not allow of a very perfect separation of the slag from the metal, whereas in a pouring furnace the slag can be taken care of readily; but practically no tungsten alloy is manufactured in this country by the latter process.

In 1916 practically no ore was imported except from Japan, although large quantities were available in South America. The North American production has been at a satisfactory rate, but at the present time there seems to be very little concentrates in New York stock for prompt shipment and the price on 60 per cent concentrates remains firm at about $18 to $20 per unit. Several months ago this material could have been obtained for about $16 and sales at even $15 were reported.

There are no new uses for tungsten, but apparently more and more will be used to keep pace with the heavy demands for high-speed tool steels. Several of the large steel companies are now manufacturing their own tungsten, but this would seem to be a rather unnecessary expedient, since there is apparently no reason why there should not be a fair and steady supply at about the present price.

California Chrome Ore

Molybdenum

This material has proved unsatisfactory from practically every standpoint. The ore runs in very small deposits, and while there is a fair amount of raw material in Canada, the government restrictions make its use in this country almost prohibitive. Some years ago molybdenum looked very promising as an alloy in tool steel, but unfortunately it was found that while the steel had very often remarkably efficient cutting qualities, it frequently ran with fine hairline seams and very peculiarly the molybdenum tended to volatilize out of the surface of the steel on heat treatment. Also in magnet steel it has not proved as satisfactory as tungsten. Metallurgically considered, molybdenum should have about twice the efficiency of tungsten.

Foreign steel makers are said to use considerable molybdenum. In fact, fair quantities of the alloy have been shipped over for use in gun steels. The addition of a small amount is supposed to increase the life of guns materially. This is apparently due to the increased durability of molybdenum treated steels under quick and enormous expansion and contraction tests. Practically no gun steels containing molybdenum have been manufactured in this country, but the reason for this is not apparent. The future of molybdenum seems problematical, and it should not be seriously considered in the list of the important metals and alloys used in the steel business.

Tungsten Mine in the Far West. The arrows indicate a tungsten vein

Technical Advances in Iron and Steel

Because of Unparalleled Prosperity, 1916 Was Not a Year of Important Developments in Processes

BY J. E. JOHNSON, JR.

IT has been said that the happy nations had no history. This saying might be paraphrased to the effect that profitable industries have no technical development. Probably both statements are true only for a limited period.

Certainly it is true that the iron and steel business has enjoyed, during the past year, prosperity that has made its palmiest days in time gone by look almost like poverty, and it is equally true that there have been in 1916 no important technical advances in the industry, no long strides to distinguish the year. These two facts stand to one another in the relation of cause and effect.

The organization of the steel works is limited. In bad times it is cut to the bone. When unexampled prosperity succeeds unprecedented dullness almost over night, as was the case a little more than a year ago, idle plants start up and to do so draw their organization in part from those still running, but short-handed. This tends to reduce the staff at the time when the drafts upon it are the greatest, for the commercial demands of the business are such that output must be obtained at whatever sacrifice of other considerations. When outputs of 100 to 110 or 120 per cent are demanded of a plant, it means that the organization must be strained almost to the breaking point before it can be built up to meet the conditions. The energy of the staff, which in normal or dull times would expend itself in methods for cheapening production or improving product, must all be devoted to output, since improvements, perhaps even those already contemplated, must be laid aside unless they are of a nature to make immediate return in the form of increased output. For these reasons, all the technical advances made this year have been of the slow, evolutionary order which comes from merely taking short forward steps in directions previously shown to be advantageous.

The By-Product Coke Oven

The past year has seen the fruition of two developments in the line of fuel which have been under way for a long time—one, the final success of the by-product oven; the other, of powdered coal as a metallurgical fuel.

The technical superiority of the by-product oven over the beehive was admitted by the well-informed two or three years ago, but the enormous war prices for benzol and toluol obtained from its gases were required to bring about its rapid introduction. These compounds are at the basis of the aniline dye industry, and are the raw materials for picric acid and trinitro-toluol, the explosives used in high-explosive shells. It is, of course, the demand from this latter source which has given the remarkable values to these compounds during the last year and a half; but with the development of the dye industry already promised it may be doubted whether these products will ever decline to their insignificant position before the war and the price they then commanded.

These compounds are present in the gases from the coke oven in the form of vapor and are recovered therefrom by scrubbing the gas with an oil which has a high absorbing power for them. This oil may be one derived either from tar or from a petroleum with a paraffin base. The scrubbing oil containing the benzol and toluol is treated in a vertical continuous still, much like an alcohol still, in which these comparatively volatile by-products are driven off as vapors and condensed in a surface condenser, while the scrubbing oil, properly cooled, is returned to the scrubbing towers.

The by-products derivable from coke-oven tar are almost innumerable, and some of these are being recovered, which in this country never were before, on account of the scarcity brought about by the war. This has contributed its quota to the earnings of the by-product coke plant, though the value is insignificant in comparison with that of benzol.

Iron Ore

In the iron-ore field nothing strikingly new has been done, although there has been steady development in the lines of magnetic separation, of washing the sandy ores of the western Mesaba and of sintering. The iron and steel industry is just beginning to realize that merchantable ore of high grade may be concentrated from unusable rock, and that the cost of treating some ores outside the furnace may be less than that of putting them through untreated. This is destined to affect the whole industry profoundly within the next few years.

The Blast Furnace

The blast furnace has had its principal development along the lines of better stock distribution, better hot-blast stoves and more economical power plants.

Fifteen years ago many furnacemen were satisfied with almost any distribution they happened to get from the apparatus installed, but this most important operation of the whole blast-furnace industry cannot be ignored without causing low output and high coke consumption. The remarkably low fuel consumption authenticated in some instances has been a gage of the inefficiency of some other plants, and the subject of stock distribution is receiving a degree of consideration to which it has been a stranger for fifteen or twenty years. The one strikingly new thing in this field is the introduction of the Slick saw-tooth distributer under the main bell, which gives the charge column a columnar structure with alternate columns of coarse and fine instead of the uniform layers produced by most systems of filling. Highly beneficial results are claimed for this improvement, and the writer has had experience which leads him to believe that these claims are correct.

Nothing radically new is being done in the field of furnace boilers, but all the conditions affecting combustion are being carefully studied and boiler efficiencies are being marked up from the common 55 per cent of the present and recent past to 70 or 72 per cent. This is a matter of better burners, better setting and better regulation of the air and gas supply and of the intensity of the draft, rather than strikingly new or great steps in this field. This increased efficiency of boilers is cutting down the technical lead of the gas engine, and, with the great economy possible with large turbine units, has about eliminated the gas

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engine from the competition for power purposes where coal is cheap, especially when the fixed charges and operating costs as well as the fuel costs of the two types of apparatus are considered.

In stoves, the tendency has continued toward increasing the quantity of brick and increasing the surface exposed by reducing the thickness of the checker walls and the size of the checker openings. One stove has been put into service which will heat 50,000 cu. ft. of wind to 1300 deg. for two hours with only two hours on gas. Theoretically two such stoves would be enough for a furnace. Practically a third will always be added by the wise operator to prevent complete interruption to operation when one comes off for temporary repairs. This is a four-pass stove and the thickness of the checker bricks in the last pass is only 1½ in. The weight of fire brick and the surface exposed are enormous. Of course, this stove would be worthless in a week on dirty gas, and the use of such stoves must necessarily involve an absolutely reliable gas-cleaning system. If stoves of this capacity shall prove durable in service, it means that the five stoves, which in recent years have been considered good practice at plants smelting refractory ores, will become obsolete, and will give way at new plants to the three stoves with which we started 30 or 40 years ago.

Potash Recovery

One of the interesting developments of the year has been the commercial recovery of potash from flue dust. R. J. Wysor, of the Bethlehem Steel Company, has conducted a very extensive research in connection with this matter and has proved that the percentage of potash entering the blast furnace charge is much more considerable than has generally been believed.

At several plants the fine dust which deposits in the base of the stoves has been collected and sold at good prices for its potash content. Where the gas is cleaned by the wet process, a very large percentage of the potash is dissolved and passes off in the cleaning water. This furnishes an additional argument for the discovery of some system for dry cleaning gases. Mr. Wysor has found that when potash is present in considerable quantities and not thoroughly removed from the gas, it has a destructive effect upon the brick work of the stoves. This constitutes an additional argument for the complete recovery and commercial utilization of this valuable material. We may expect to see steady if not spectacular progress, in this direction, for several years to come.

Steel Production

The year saw rapid strides in the introduction of pulverized fuel in the open-hearth furnace.

POWDERED COAL

is being used exclusively for open-hearth and heating furnaces in one steel plant, and is being tried out in various others. The detail steps necessary to produce this fuel successfully are now understood, and enough is known about its combustion to permit its use, though those best informed are most inclined to doubt whether they have achieved the perfect method of combustion.

In open-hearth furnaces the coal is blown into the outer end of the port by a jet of air under relatively high pressure, and is surrounded by a jet of compressed air which carries it into the current of heated air coming up through the regenerator. Special precautions are taken in the construction of slag and ash pockets over the regenerators to prevent their being filled by the fine ash from the coal. The large amount of radiant heat obtained from the direct combustion of the carbon particles in the furnace is found to be a decided advantage. On the economic side it may be roughly stated that it costs less to pulverize than to gasify a ton of coal, and that the gas contains only 80 per cent of the energy of the coal after it is produced, while the powdered fuel contains it all.

This development is regarded as a technical and commercial success at least in some plants, and the importance of the gas producer in the steel works appears likely to sustain a hard blow.

USING WASTE HEAT

Investigations of the open-hearth furnace in recent years have shown that its thermal efficiency is exceedingly low. The checker work cannot be built large enough to extract anything like all the heat from the waste gases, and in order to prevent the complete loss of this, the practice was started two or three years ago of introducing waste heat boilers into the system, placing them between the regenerators and the stack. It was well known, of course, that some power could be obtained in this way, but it was by no means certain the commercial value of this power would exceed the fixed charges on the installation. This fact has now been positively ascertained and the use of waste-heat boilers in conjunction with open-hearth furnaces seems likely to grow. This, of course, is a return to the practice standard in puddling mills a generation or more ago, when a large quantity of the steam required was developed in boilers erected over the puddling furnaces.

DUPLEXING

The duplex process has made decided gains and it seems probable that within a few years most of the steel made in the large works will be produced with this process. The Bessemer will undoubtedly continue to be used for pipe and certain other purposes, such as bolt stock, for an indefinite period. The open-hearth will also continue to be used indefinitely at plants too small to consume the output of a duplex installation, but in the rest of the steel producing field the preponderance of the duplex process seems likely to increase.

The records of the Patent Office indicate that at the largest steel plant which uses high-phosphorus iron progress has been made in the last year or two in the concentration of the phosphorus in a portion of the open-hearth slag, so as to practically equal that in basic Bessemer slag, thereby recovering a valuable by-product.

Ingot Casting

The question of casting ingots is receiving constantly more and more attention. The extreme severity of the specifications for shell rounds, of which millions of tons have been made for the European nations in the past year and a half, has been partly responsible for this. The yield of merchantable steel in some plants has been less than 50 per cent of the weight of the ingots, with little or no disposition available for the remaining 50 per cent except remelting. This has put a decided premium on methods of casting which could reduce the losses from piping, segregation, etc.

It is claimed by some that the shorter pipe in the ingot cast big end up is more than offset by the fact that the cross-section of the ingot is larger, and that the gross volume required to be cropped is larger than that of ingots cast in the standard way. This seems contrary to the best theory of the subject, and rapid progress is to be expected in casting ingots big end up. Other methods of eliminating or reducing the pipe in the ingot are receiving serious consideration.

No advances in steel rolling have been made in the past year, except the minor steps incident to normal

growth. The electrically driven reversing blooming mill is making rapid strides in spite of the high fixed charges involved in its introduction.

The Automobile as a Consumer

The automobile has made itself increasingly felt as a consumer of iron and steel. One steel works in the Central West, which has made a specialty of alloy steels for the automobile trade, has been swamped with orders in spite of great increases in capacity. A large part of its tonnage is special alloy steels, such as chrome-vanadium, chrome-nickel and the like. The largest producer of automobiles has let contracts for the construction of two blast furnaces whose output will go directly into finished castings by a process not yet disclosed. These will be used for automobiles and gas tractors.

Centrifugal Casting

Outside the process just referred to, of making castings direct from the blast furnace, there has been nothing strikingly new in the production of castings, although for a year or two an active interest has been taken in making hollow cylindrical castings in rotating molds. Very remarkable castings in steel, iron and bronze have been made in this way. The centrifugal force developed by the high rotative speed of the mold tends to densify the metal and at the same time gives a chance for the evolution of the gas which it contains. It is as if the effects of gravity in throwing off gases were multiplied many fold.

In recent months it is understood that a process of casting in this way has been developed with particular reference to short sections of cast-iron pipe, like sewer pipe, and that an improvement has been added to the process whereby the castings are removed from the mold as soon as they are set, so that very great outputs can be obtained from a given machine. Full details are not at hand, but the process seems to promise well.

The Electric Furnace

One of the important developments of the past year has been the increase in the use of electric furnaces. These are in practically no case for the production of iron or steel, but merely for melting or refining iron and steel already produced. The quality of material which can be produced in this way is undoubtedly superior to that which can be produced in the open-hearth furnace, and is probably equal to the best that the crucible can do, because the electric furnace is simply a large crucible, not requiring the presence of any gases of combustion for heating as the open-hearth does. It could even be worked *in vacuo*, if that were necessary. Triplexing, which generally means the refining of steel made by the Bessemer and basic open-hearth in the electric furnace, is increasing for special qualities of material.

For high-grade materials, where quality is of paramount importance, the electric furnace seems to have a field all its own, and owing to the fact that under special conditions current for it can be bought from public service companies during "off-peak" periods, its installation cost is not necessarily high. This permits its use in plants smaller than otherwise would be justified in making their own steel.

Steel Rails

The steel rail has had a position of secondary importance commercially during the past year, because the economic pressure under which the railroads have been laboring for several years, exerted by the commissions on one side and the labor unions on the other, has almost completely prevented the construction of new lines. At the same time the growth in the use of steel for other purposes has been enormous, and these two factors have reduced the steel rail from its once dominant position to a subordinate one. Nevertheless, the subject continues to excite the liveliest interest.

In the form of rails steel receives the hardest service to which it is subjected. About 40 years ago the railroads used 10-ton cars with a gross weight of 16 or 18 tons, and 56-lb. rails; to-day they are using almost exclusively 50 and 70-ton cars with gross weights of 72 and 100 tons, while the first of the 120-lb. rails are now beginning to appear. In other words, in 40 years the load on the rails has increased four to six times, and the weight of the rail has barely doubled; on the average it has not nearly done so.

The railroads continue to express their disapproval of the steel men because the latter cannot guarantee their product absolutely against failure under these conditions. The transverse fissure continues to constitute a terrible menace to the railroads, since the section of the head may be reduced to a fraction of its safe area at one of these fissures without the latter ever appearing on the surface until its failure under load occurs, and a train wreck results. This is a comparatively new defect, or at least its importance in the total of rail defects has grown enormously in the last few years. The experts of the railroads are trying to attribute it to bad mill practice, but no adequate proof of this contention has as yet been adduced. On the other hand, the probability that these failures are caused by plastic flow of the steel in the surface of the head, due to the tremendous local loads put upon them by the wheels, does not appear to have been sufficiently investigated.

Tool Steels and Ferroalloys

One of the interesting features of the steel business in the past year has been the spectacular advance in price of tool steels and the alloy metals used for producing high-speed steel. No startling technical developments have so far resulted from the astonishing prices which these materials have commanded, but uranium steel gives a promise which, if confirmed, will have a profound influence on the whole high-speed steel situation. The use of vanadium has experienced a healthy growth. In the days of early development too much was claimed for it in some cases, and the reflex of this was injurious, but it has now been demonstrated beyond a possibility of doubt that vanadium imparts elastic and shock-resisting qualities which cannot be obtained with any other element so far discovered.

It will be seen that this year, satisfactory as it has been from a commercial point of view, has done little, in comparison with some of its predecessors, to advance the technical side of iron and steel manufacture. We may hope, however, that a part of the profits earned during these conditions will be set aside to further that development which is necessary if it is to keep the place accorded to it by impartial authorities as the most advanced of the world's great industries.

Waste Heat Boilers at Open-Hearth Furnaces

The combination of the output of waste gases from two adjacent open-hearth furnaces is the object of an invention (U. S. 1,195,521—Aug. 22, 1916) credited to Robert M. Snyder, Wilkinsburg, Pa. The claim is made that an equalization of the output into a more constant resultant and a reduction in the sizes of boilers used for each of the furnaces as compared with the sizes ordinarily used with single furnaces are attained. The waste gases from one or both of its furnaces can enter either a single boiler or two boilers as desired.

The New Status of American Shipbuilding

At Present a Close Second to Great Britain—Much Depends on Operations of Seamen's Act, the Shipping Board and War Taxes on Foreign-Owned Ships—Years to Replace Tonnage Destroyed

BY W. L. CROUNSE

AN extraordinary combination of events has served to render the year just ended the most momentous in the annals of the great American industry engaged in the building and operating of ships. The developments of the twelvemonth include what promises to prove the largest shipyard output of any calendar year in the history of the country; an accumulation of work on hand far in excess of that at any previous period, and surpassing that of any country except Great Britain; the rapid expansion of the leading shipyards and the launching of new companies already provided with contracts for construction running far into the future; the invasion of American shipyards by foreigners, chiefly Norwegians, and the construction, sale and transfer to foreign flags of a large aggregate tonnage of American built ships; the transfer to the American merchant marine of a considerable number of American-owned vessels previously operated under foreign flags; the authorization by Congress of the largest naval construction program ever undertaken in the United States, involving the building of more than 150 warships aggregating over 800,000 tons, to be placed in three years, of which more than 300,000 tons have already been contracted for; the adoption by the Navy Department of a policy of navy yard expansion with a view to the construction of warships in no less than eight yards and the equipment of a great naval fleet base on the Atlantic and on the Pacific coasts; the temporary nullification of the La Follette seamen's act by the extraordinary conditions existing in the shipping industry, assisted by administrative regulations relaxing the more drastic features of the law; and the enactment by Congress of a statute creating a Federal Shipping Board to procure and operate $50,000,000 worth of cargo ships and to supervise and regulate the operations of vessel owners in the American merchant marine.

Impressive as are the figures showing the construction of the past year they seem small when compared with the enormous aggregate of work on hand at the present time, which, on the basis of the last official returns, is estimated at 1,500,000 gross tons of steel construction. This gigantic total has been steadily accumulating throughout the year and in view of the vast amount of new business yet unplaced, it is believed to be only a matter of a comparatively short time when the construction in hand will approximate 1,750,000 tons.

The following table shows by fiscal years the output of American shipyards since 1900:

Output of American Shipyards Since 1900 by Fiscal Years

1901	483,489	1909	283,090
1902	468,831	1910	342,068
1903	436,152	1911	291,162
1904	378,542	1912	232,669
1905	330 316	1913	346,669
1906	418,745	1914	316,250
1907	471,332	1915	225,122
1908	614,216	1916	325,414

The largest fiscal year output in the history of the industry was recorded in 1908 when 614,216 tons were constructed. That year was abnormal on several accounts, notably because shipbuilding and ship-owning interests, in hopeful anticipation of the enactment of pending legislation in aid of the American merchant marine, which Congress ultimately refused to grant, made herculean efforts to clean up their work on hand and to plan new construction on a large scale. The slump in business in the fiscal year 1909, which recorded a decline of 60 per cent, gives additional point to the sporadic character of the movement that found its stimulus in the ship subsidy legislation which Congress promised but never passed.

The location of the yards producing the record-breaking tonnage of 1916, together with the power and rigging of the vessels constructed, are of special interest at this time. The figures for December are still lacking but an accompanying table embraces the statistics for the eleven months ending Nov. 30, exclusive of 49 vessels, aggregating 33,637 gross tons built for foreign account:

American Ships Built in Eleven Months

Yards	Sailing	Steam	Gas	Unrigged	Total
Atlantic and Gulf:					
Number	44	74	215	213	546
Tonnage	12,511	197,143	14,066	72,030	295,750
Pacific:					
Number	6	20	161	76	263
Tonnage	3,903	57,619	8,814	8,670	79,006
Great Lakes:					
Number	1	40	36	37	114
Tonnage	2,320	89,161	10,267	5,968	107,716
Western Rivers:					
Number	....	17	98	28	143
Tonnage	....	1,932	3,096	946	5,974
Total:					
Number	51	151	510	354	1,066
Tonnage	18,734	345,855	36,243	87,614	488,446

Of the vessels included in the above table 130, of 361,170 tons, were of steel and 936, of 127,276 tons, were of wood. Of the 49 vessels built for foreigners 36, of 372 gross tons, were of wood and 13, of 33,265 tons, were of steel.

The growth during the past calendar year of the shipbuilding boom—for genuine boom it has been—is indicated by the following figures showing the output of the American yards by months including the construction for foreign account:

Output of American Shipyards in 1916

1916	Vessels	Tons	1916	Vessels	Tons
January	48	26,408	July	120	28,682
February	44	32,562	August	126	66,599
March	82	37,967	September	102	49,929
April	115	28,413	October	115	70,199
May	114	61,881	November	100	90,636
June	122	51,848	*December	90	80,000

*Estimated.

Norway as Buyer and Builder of Ships

One of the most astonishing of the recent developments has been the enterprise of Norwegian ship-owners in placing contracts in American shipyards for cargo vessels. For many months the Norwegians have been engaged in buying ships in every market and especially in the United States. It is conservatively estimated that no less than 200,000 tons of vessels built and numbered for the American merchant marine have been sold to foreigners in the past year and it is believed that more than half have been purchased by Norwegians.

According to the most reliable figures available there are now building and under contract in American yards approximately 600,000 tons of vessels for foreign account, of which more than one-third are probably for Norwegian owners. In a recent report to the State Department U. S. Consul General Dennison of Christiania, says:

The losses to Norway's shipping arising from the war have been greater than those experienced by any other neu-

tral and stand second to those of only Great Britain and France. In spite of this gradual reduction in tonnage, Norwegian ship-owners have placed orders for a large amount of new tonnage in home and foreign yards. The total amount cannot be definitely stated, but it is estimated at about 1,200,000 tons, a large amount of which is to be built in American yards. A considerable number of steamers are to be constructed in Canada and some in China. Newly built steamers have also been recently purchased in Japan. The cost of all this new tonnage, however, is very high. The cost of building ordinary cargo vessels in Norway before the war was between $35 and $40 per ton, according to the size of the vessel. Owing to the great increased cost of material, labor, etc., prices have increased considerably, and it has been reported that some of the latest contracts that call for fairly prompt delivery have been executed at about $187 per ton. Under a good many contracts, however, deliveries are to take longer and run in some cases to the end of 1918. Such contracts, which have been largely placed in the United States and Canada, have been concluded at from $130 to $150 per ton, according to time of delivery.

The Norwegians have been among the most enterprising and daring purchasers and so comprehensive have their operations in this country become, especially in the placing of contracts for new construction, that there has recently been sent to the United States a representative of the Norske Veritas—the Norwegian prototype of the British Lloyds—whose duty it is to see that ships built in this country for Norwegian account conform to the Veritas rules. This fact is perhaps the best answer to the suggestion so frequently heard of late that a large part of the ships purchased and contracted for in American yards by Norwegians are designed ultimately to be transferred to the merchant marines of the belligerent countries of Europe and especially to Germany.

An interesting bird's-eye view of conditions in American shipyards at the present time is given in the table on page 29 showing the steel merchant vessels building or under contract in private yards on Dec. 1, 1916, according to builders' returns to the Bureau of Navigation, Department of Commerce.

United States Close Second to Great Britain in Shipbuilding

The official reports of construction on hand Jan. 1, 1917, in the leading shipbuilding countries of the world will place the United States a close second to Great Britain, which stands at the head of the list. The steel merchant ships under construction or contract in American yards on Oct. 1, 1916, numbered 417 of 1,454,270 gross tons, while on June 30, 1916, the shipyards of the United Kingdom had 440 ships of 1,540,218 tons under construction, nearly all steel steamers. Since the dates quoted the steel tonnage under contract in American yards has risen slowly, because of the large number of vessels completed. There has also been a limited increase in this class of work in British yards owing to the tremendous demand for the building and repairing of war vessels.

The prices at which the work now on hand in American yards has been taken have undoubtedly been very remunerative. In spite of the rapidly mounting material and labor costs, it is believed that the shipyards have in nearly all cases been able to protect themselves by options covering their contracts and the prices at which some recent orders have been placed certainly show generous margins. Ships which, before the war, could have been contracted for at $50 to $75 per ton, according to size and equipment, have recently been ordered at $125 to $200 per ton and in some cases of great urgency, where early deliveries were demanded, the prices have been even higher. The greatly increased volume of production has enabled the shipyards to institute numerous economies and the willingness of ship-owners to accept conditions imposed by builders has enabled the latter to standardize their product to some extent and thus to save a great deal over the cost of turning out ships built to individual specifications.

The pressure of American shipyards has been materially increased as the result of the destruction of merchant vessels by the belligerents in the European war and this pressure is likely to become much greater as hostilities continue. The gross tonnage of the merchant marines of the world at the beginning of the war was reported by Lloyds as 49,000,000 tons. Of this amount probably 5,000,000 tons of ships belonging to the Allies and to neutrals have been destroyed and nearly 5,000,000 tons belonging to the Central European powers interned in their own or neutral ports. Between 5,000,000 and 6,000,000 tons are estimated to have been commandeered for government purposes by the belligerents, although a large part of this tonnage has been engaged in the transportation of supplies intended for the civilian population as well as for the armies and thus cannot be said to have been wholly withdrawn from the merchant service. The commandeered vessels are reckoned as an almost total loss by the best authorities because of the rapid deterioration of these vessels, which are being run without repairs and under extraordinary service conditions. The interned vessels are being fairly well cared for, but many of them will be almost valueless when the war is over and all will require heavy expenditures for rebuilding, repairs, and up-to-date equipment.

Years Needed to Restore Shipping Facilities of 1914

Assuming that new construction has replaced one-half of the tonnage destroyed, interned and commandeered, it appears to be a fair calculation that the world's available shipping, should the war end in a year, will show a shrinkage of seven or eight million tons. Should the conflict last longer the loss undoubtedly will be greater. In any event the producing capacity of the shipyards of the world, now figured at about 3,000,000 tons per annum—maximum output was recorded in 1913 with a total of 3,332,882 tons—will be heavily taxed for several years to restore the status of 1914. The demands made upon American yards will be greatly increased because of the necessity on the part of the belligerent countries of Europe to utilize for some time to come a large part of their shipbuilding facilities for the restoration and expansion of their navies.

The facilities of the shipyards of the country have been further taxed during the past year by the adoption of the largest naval construction program in the history of the nation. In the placing of contracts for this construction the Navy Department has confronted many difficulties, certain of which are of its own making. When the 1916 program was advertised several of the leading shipyards, already fully provided with contracts, reserved space for the larger naval vessels and presented bids therefor, which, in the light of present day costs, are now seen to have been extremely moderate. Because they represented an advance over the 1915 figures, however, the Secretary of the Navy rejected them, criticised the bidders in harsh terms and directed that the battleships be constructed in Government navy yards. The event has proved that the shipyards were most fortunate in having their bids rejected as they were thereby enabled to take a considerable amount of commercial work on vastly more profitable terms. Under the circumstances it was hardly to be expected that the private shipyards would manifest much enthusiasm with regard to the enormous three-year program; nevertheless, the shipbuilders exhibited a most commendable spirit of patriotism and at this writing it seems probable that the entire 1916 allotment will be contracted for at a total cost but little if at all above the limit fixed by Congress.

The Matter of the Navy Department Contracts

In spite of the success of the Navy Department in placing the 1916 contracts for warships, the outlook

MERCHANT SHIPS UNDER CONSTRUCTION AND CONTRACT IN AMERICAN YARDS ON DEC. 1, 1916

Shipyards	Number	Gross Tons
American Bridge Company, Ambridge, Pa., and Trenton, N. J.	99	50,652
American Shipbuilding Company, Cleveland	18	68,300
Anderson Steamboat Company, Seattle, Wash	2	11,400
Baltimore Dry Docks & Shipbuilding Company, Baltimore	10	34,245
Bath Iron Works, Bath, Me	3	*1,600
Bethlehem Steel Company, Sparrows Point, Md	14	91,997
Charles Barnes Company, Cincinnati	2	375
Chester Shipbuilding Company, Chester, Pa	15	74,200
Clinton Shipbuilding & Repair Company, Philadelphia	1	560
Cowles Shipyard Company, Buffalo, N. Y	1	36
Dubuque Boat & Boiler Works, Dubuque, Iowa	2	1,415
Fore River Shipbuilding Corporation, Quincy, Mass	12	79,700
George Lawley & Sons Corporation, Neponset, Mass	1	75
Great Lakes Engineering Works, Detroit	12	*51,800
Great Lakes Towing Company, Cleveland	3	286
Harlan & Hollingsworth Corporation, Wilmington, Del	13	56,344
Howard Shipyards Company, Jeffersonville, Ind	5	2,950
J. F. Duthie & Co., Seattle, Wash	8	44,040
James Rees & Sons Company, Pittsburgh	1	300
Manitowoc Shipbuilding Company, Manitowoc, Wis	9	16,852
Merrill-Stevens Company, Jacksonville, Fla	4	2,500
Moore & Scott Iron Works, Oakland, Cal	7	35,600
Newport News Shipbuilding & Dry Dock Company, Newport News, Va	13	91,673
New York Shipbuilding Company, Camden, N. J	25	123,554
Pennsylvania Shipbuilding Company, Gloucester, N. J	10	65,000
Pusey & Jones Company, Wilmington, Del	12	11,850
Riter-Conley Mfg. Company, Baltimore, Md	2	3,000
Seattle Construction & Dry Dock Company, Seattle, Wash	10	57,500
Skinner & Eddy Corporation, Seattle, Wash	11	64,370
Spedden Shipbuilding Company, Baltimore	2	660
Standard Shipbuilding Corporation, New York	8	38,400
Staten Island Shipbuilding Company, Port Richmond, N. Y	5	8,841
Sun Shipbuilding Company, Chester, Pa	2	14,200
Tampa Foundry & Machine Company, Tampa, Fla	1	2,000
Tank-Ship Building Corporation, Newburgh, N. Y	2	1,000
Texas Steamship Company, Bath, Me	4	26,000
Toledo Shipbuilding Company, Toledo, Ohio	7	19,700
Union Iron Works, San Francisco	28	*175,028
Willamette Iron & Steel Works and Northwest Steel Company, Portland, Ore	8	45,600
Wm. Cramp & Sons Ship & Engine Building Company, Philadelphia	8	51,400
Total	400	*1,428,003

*Incomplete.

Note:—Wooden ships building Dec. 1, which are not included in this table, increase the total by approximately 156,000 tons. Of the steel ships under contract the builders expect to launch before July 1, next, 294 vessels of 904,231 gross tons. In addition approximately 60,000 tons of wooden ships will be completed in the same period. The remainder of the steel construction, including 106 vessels of 523,772 gross tons, will be launched in the fiscal year ending June 30, 1918.

for the remainder of the three-year program—42 vessels in 1917 and 48 in 1918—is not particularly encouraging, unless the Department relies solely upon the patriotism of the private shipyards. Not only are these yards crowded with work but at a time like the present naval work is undesirable for numerous reasons. It requires much in the way of facilities and special equipment which are not available for commercial work. The necessity for scrupulously observing the laws regarding labor on government contracts is a demoralizing factor, while the Navy Department's system of inspection introduces another irritating element. Government work is also incompatible with the movement to standardize ship construction, which is making rapid progress in many private yards; in fact, private parties desiring to place contracts at the present time are almost invariably obliged to accept standardized ships with remote dates of delivery or go without.

Under all the circumstances it is clear that the Navy Department is relying upon the public spirit of the private shipbuilders to provide for the construction of the remainder of the three-year program and does not contemplate letting any of its contracts at prices that will show a profit at all commensurable with that now earned by well-equipped yards on commercial work.

Plans have recently been adopted by the Navy Department for the wholesale expansion of the shipbuilding facilities of no less than eight of the principal navy yards and for the creation of a completely equipped naval fleet base in New York harbor and in San Francisco Bay. The yards at Norfolk and Philadelphia are to be enlarged to permit the construction of the largest battleships and additional facilities are to be provided at New York and San Francisco where vessels of capital size are now being built. The Boston and Bremerton (Wash.) yards will be fitted up to build cruisers and other vessels up to 12,000 tons and the Portsmouth and Charleston yards for the construction of gunboats, destroyers, submarines and smaller craft.

The Department officials insist that this project does not reflect the desire of the Secretary of the Navy to render the Department independent of the private shipyards of the country, but it goes without saying that the proposed expansion will enable the Government to build a steadily increasing proportion of the warships annually authorized by Congress, and experience has shown that whenever Congress has provided manufacturing facilities of any kind its policy has been to com-

pel the executive to utilize those facilities to the utmost, apparently regardless of expense and to call upon private manufacturers only for those things which the Government cannot make.

American Merchant Marine After the War

It is a significant fact which has an important bearing upon the future of the American shipbuilders that, in spite of the large amount of construction completed during the past year, the American merchant marine is but little larger to-day than it was a year ago and it may lose a very considerable tonnage as soon as peace is declared in Europe. At the beginning of 1916 our merchant marine embraced 8,440,987 gross tons. In the year there were added by transfer, under the act of Aug. 18, 1914, about 40,000 tons, and by construction about 560,000 tons. These gains, aggregating about 600,000 tons, have been heavily invaded by the transfer to foreign flags of American vessels amounting to 200,000 tons and by losses from various causes estimated at 240,000 tons. The net gain for the year, therefore, will approximate 160,000 tons or less than 2 per cent.

The possibility of the loss of a large tonnage with the end of the European war hinges upon conditions which cannot now be accurately appraised. Under the act of Aug. 18, 1914, American owned vessels previously flying foreign flags have been transferred to our merchant marine aggregating 625,000 gross tons. The cost of operating these ships under United States laws has been much greater than formerly under foreign flags, but considerations of safety, taken in connection with the large profits which nearly all ship-owners have made during the past two years, have served to render unimportant the difference in expense of operation.

When the war is over, however, the question will arise as to whether it is to the advantage of the owners of these vessels to continue them in the American merchant marine or to retransfer them either to the foreign flags under which they formerly sailed or to those of other foreign countries. Conditions in the merchant navies of the world, especially those of the belligerent nations, will undergo many important changes with the resumption of peace and vessel owners contemplating a change of flag will be forced to consider the high post-bellum taxes and service liabilities which will undoubtedly be imposed upon their merchant ships by some if not all of the belligerents. What proportion of the large tonnage transferred to American flag at the beginning of the war will seek to resume foreign registers after its termination is now but a matter for speculation, but the outcome will be of great importance to the American merchant navy.

Seamen's Act As Yet Under No Real Test

The progress recorded in the shipbuilding industry during the past year is rendered the more notable by the fact that Congress, by the passage of the so-called La Follette seamen's act of March 4, 1915, deliberately placed serious impediments in the way of the development of the American merchant marine. Forced through House and Senate by the active work of the organized labor lobby, regarded by government experts as a measure of more than doubtful wisdom and vigorously denounced by shipbuilders and ship-owners, who freely predicted that the last remnant of the American merchant marine would soon disappear as the result of its vicious provisions, the law still stands upon the statute books without amendment. Radical changes in the construction and equipment of vessels were required by the act, but probably the most drastic provisions were those relating to the employment of crews, which discriminated heavily against foreigners and especially against Asiatics.

Early in 1915 the demand for ships and for cargo space speedily outran the supply, freight rates doubled over night and the owners of steamship and sailing vessels alike made small fortunes with every voyage. Under such extraordinary conditions ship-owners and ship captains had no time or disposition to quibble over technicalities which in normal times might spell profit or loss.

The real test of the seamen's act will come when the war is over. Even then the abnormal conditions now prevailing will continue to be felt for a long time to come and it is doubtful whether the complete status which prevailed before the war will ever be restored. The permanence of the seaman's act, however, will probably depend upon the continued prosperity of the American merchant marine.

Broad Powers of the Shipping Board

No legislative accomplishment of the past half century dealing with the building and operating of ships compares in importance with the so-called shipping act, which became a law on Sept. 7, 1916. Though the personnel of the shipping board was announced on Dec. 23, it will be many months before even the most experienced specialist in water transportation will venture an opinion as to the wisdom of the law as a whole. For more than fifty years Congress has sought to provide some form of federal aid for our shipping in the foreign trade. The federal shipping act of 1916 is a compromise measure fought through Congress under whip and spur after a much more comprehensive bill had been defeated by the opposition of leading members of both parties who objected strongly to the principle of government ownership upon which the proposed statute was based. The law as finally enacted clothes a shipping board of five members with powers to be exerted with reference to the American merchant marine far greater than those now exercised by the Interstate Commerce Commission over the railroads of the country.

A sharp line of demarcation divides the functions of the shipping board. On the one hand, it is authorized to procure by purchase or construction $50,000,000 worth of cargo ships and set them at work carrying American merchandise to foreign countries, while, on the other, it is charged with the duty of regulating the rates and general business practices of the American merchant marine. In the opinion of many experts these two classes of functions might well have been bestowed upon two separate boards and it is possible that if Congress had finally decided to make the acquisition and operation of merchant vessels a permanent feature of the board's work it would have placed the duty of regulating the merchant marine in other hands. Certainly there is an extraordinary anomaly in the proposition that a board of five men shall be authorized to operate $50,000,000 worth of government-owned cargo ships in direct competition with privately owned vessels, at the same time exercising the most comprehensive, not to say arbitrary, control over the rates and practices of the government's private competitors.

It has not been possible since the shipping act was passed to find an expert either in the Government service or in the shipping business who believes that the provision authorizing the board to procure $50,000,000 worth of cargo ships is anything but a dead letter, so far at least as the transportation problem of to-day is concerned. Assuming that the tonnage procurable for this sum at present prices could be had, the amount would be so insignificant as to be wholly negligible. Furthermore, the expenditure of $50,000,000 of the people's money for vessels, which, within a few months of the end of the present European war, will probably be worth only a fraction of their cost, regardless of their condition at the time, would be unjustifiable extrava-

(*Continued on page* 71)

The Advance in American Shipbuilding

Plant and Methods Brought to a High Standard—Labor Situation Not in Line with Improvement in Other Respects

HAS the shipbuilding industry of the United States taken advantage of the opportunities now before it? Is it preparing to build the vast tonnages that will be required to restore the losses due to the war and to replace the bottoms diverted to war service?

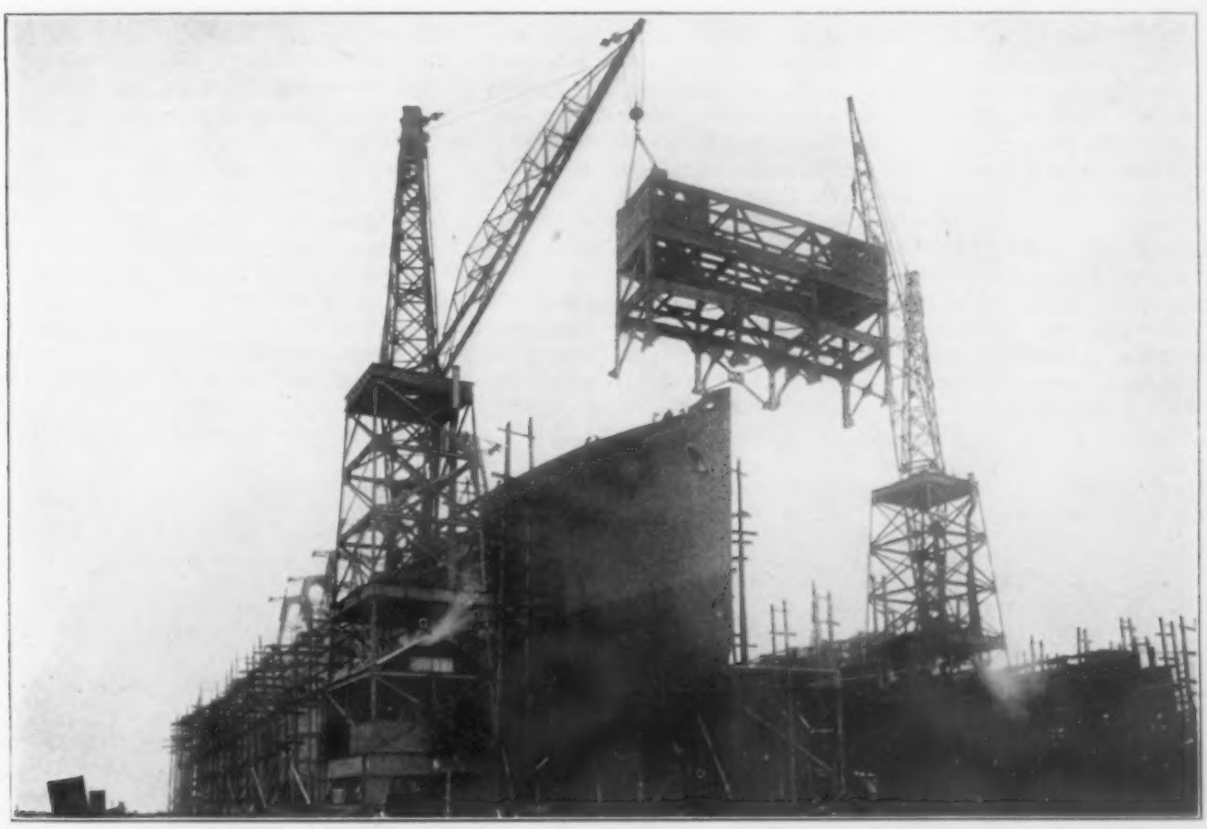
The shipyards of the country have had in the past two years to face the problem of turning out more vessels than they were ever designed to handle. This had to be done in a rising labor market and in a period of high prices and delayed deliveries of material, all of which conditions were aggravated by the lack of organization and facilities to cope with the unusual conditions. It is sufficient to say at this point that the shipbuilders, at the beginning of the war, were far from being prepared to meet the demands which were shortly to be made upon them. But they were not necessarily to blame for this state of affairs. They had been hampered for years by adverse legislation which had gradually driven American ships from the ocean and there was but little encouragement to build ships except for the protected coastwise trade. While one or two of the shipyards at the beginning of the war had plans for extensions, there had been an indefinite postponement of their execution.

All the conditions existing before the war, however, have been reversed. The existing shipping laws, while they restrain, do not prevent the operation of American vessels, for much of the competition of German and British steamers which made the operation of American ships unprofitable has been removed. Freight rates have advanced to a point where a vessel will pay for itself in a couple of voyages. Under such conditions, owners can afford to comply with the drastic provisions of the American shipping laws, with their consequent heavy expense of operation, and to pay the fancy prices demanded for labor and material entering into the construction of new vessels.

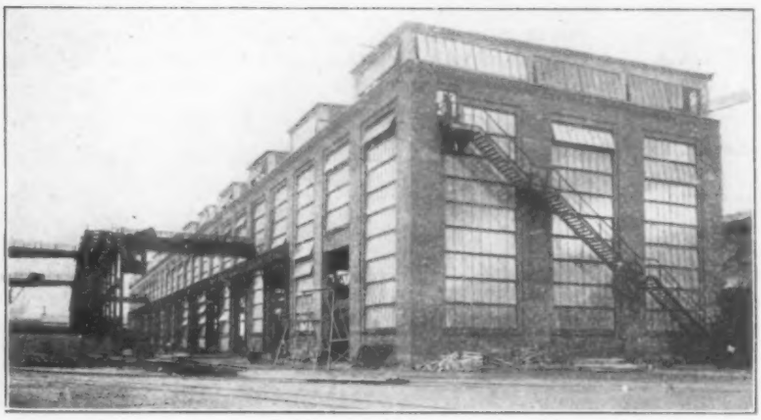
Meeting Sudden Expansion in Demand

The problem then confronting the shipbuilders has been how best to meet the sudden demand that has been forced upon them, without, at the same time, overburdening themselves with plant and equipment which would be rendered idle by a sudden cessation of the demand for vessels brought about by an unlooked-for termination of the war. The second phase of the problem is not now of such vital importance as it was earlier. The destruction of shipping has proceeded to such an extent that it is estimated that there is at least five years of good business ahead in the shipbuilding industry. This time will be required simply for the replacement of tonnage that has been destroyed and to make up for the natural growth of bottoms that was interrupted by the war.

It is in the first phase of the problem that the shipbuilders are now most interested. An increase in production in any industry can be accomplished in several ways: By increasing plant; by improving equipment; by speeding up existing equipment; by purchasing outside a portion of the material formerly made in the plant, thus releasing equipment for other purposes; by improving the methods of



The most recent practice in shipbuilding, as at the plant of the Maryland Steel Company, calls for the assembling as complete units in the shop or on the ground of many parts of the ship. These are later placed as a whole in the vessel.



The ship shed in the newer shipyards is a manufacturing building of the most modern type. The adjoining stock yard provides for moving supplies with a minimum of handling

doing work, and, finally, but of high importance, by improving the efficiency and productivity of the labor force.

Shipyard Improvements

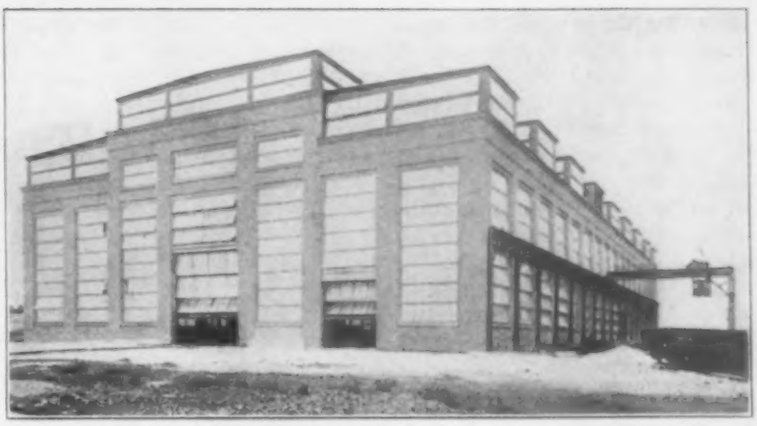
Have the shipbuilders taken advantage of all these possibilities to meet the present emergency and the future demand? One or more of all the several methods enumerated above have been adopted in one shipyard or another, but so far as can be discovered no one yard has made use of all. Money has been spent, and is being spent, like water for plant extensions, new tools and equipment, and the changes in the physical appearance of the yards are truly imposing. New ways have been laid down; new shops have been built and old ones extended; larger, heavier and more powerful tools are being installed; additional handling equipment has been bought, and so far as plant is concerned the shipyards do appear to have made provision for the future.

While the number of new launching ways laid down is not great, these new ways are not a measure of the increase in the capacity of the yards. The real limit to shipbuilding is the ability of the shops to machine and fabricate the material entering into the ship, and of the handling equipment to move it into place in the vessel. The number of riveters and other workmen that can be put to work around the vessel itself is almost unlimited. The real difficulty lies in supplying these men with material on which to work.

Larger shops enable more material to be prepared in a given time, and the speed of assembling this into the hull has been increased by the additional crane equipment, over the launching ways. The net result is that a ship spends a shorter time on the ways than formerly, and therefore on a given set of ways more ships can be built. Measured by this standard, the capacity of the shipyards has been materially increased, even if no new ways had been laid down. If the additional ways that have been constructed are taken into consideration it is safe to say that there has been an increase of at least 50 per cent in the capacity of the yards. The term "capacity," however, is a misleading one, as applied to shipbuilding, for the tonnage of vessels that a yard can turn out depends entirely on the character of work done. An oil tank ship involves more work and requires a longer time on the ways than does a bulk freight vessel, and a battleship requires a longer time than either. If a yard were continuously engaged on one kind of work, as freighters, tank ships, passenger vessels or warships, the increase in capacity could be determined

Ship sheds are now equipped with every type of handling device to minimize the effort in moving work and to expedite production

absolutely. Inasmuch, however, as American yards build all types of vessels, no exact statement can be made as to the extent of the new capacity. This point is discussed somewhat more fully below.



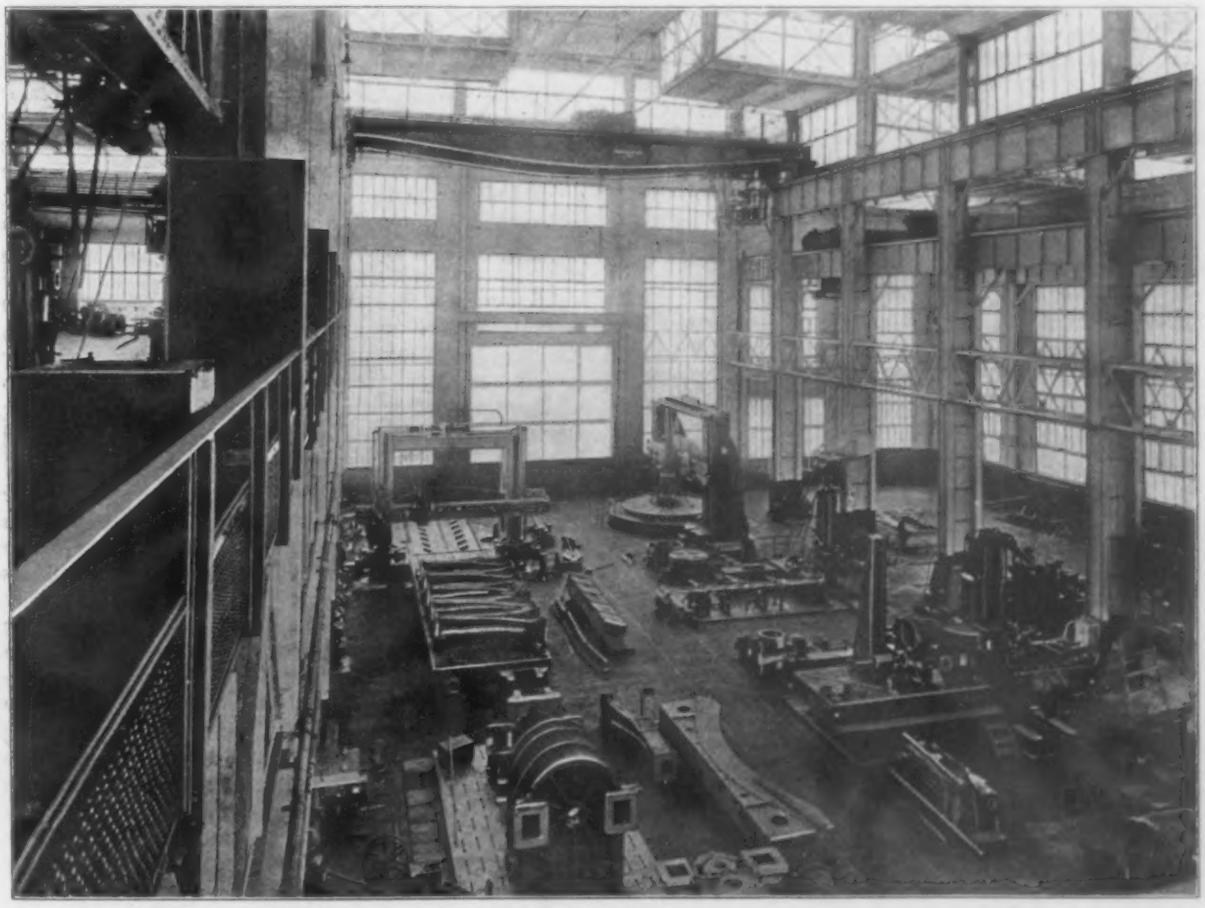
The machine shops in the shipyards will stand comparison with those of any industry with respect to arrangement, construction and equipment

What Various Yards Have Done

It may be interesting to note the changes that have taken place in some of the larger yards in the effort to bring their capacity more nearly in line with the demands on them. No comparison can be made of the changes, for the yards have had to meet widely different conditions in the solution of the problem. For instance, the New York Shipbuilding Company's plant at Camden, N. J., was originally designed so that extensions could be made simply by duplicating ship ways indefinitely alongside of the older ones, and extending the shops at right angles to the ways along their existing lines. The shops communicate directly with the sheds under which are the ways—at the New York plant the ships are built under cover—and as new ways are laid down the necessary shop capacity to take care of them is obtained simply by extending the shops in front of the head of the ways. This is what has been done in the present case. A new set of ways capable of taking a vessel 800 ft. long has been provided. The machine shop has been extended 120 ft. and equipped with heavy lathes and planers. At the same time a new storehouse was constructed, releasing a gallery in the present machine shop which had formerly been used for that purpose. These changes, coupled with several minor ones, have enabled this company to increase its capacity with a minimum of trouble. It has been fortunate, however, in that it was unrestricted as to geographical conditions. Located on a river, with no other plants on either side of it, the company was unhampered by any lack of real estate or water frontage. This, coupled with the fact that the plant is comparatively new and well balanced in all departments, has made a very marked increase in capacity less noticeable than relatively smaller increases in other plants.

The reverse of the above conditions obtained at the Cramp yard at Philadelphia. This is located in the heart of a great city, and the room along the water front in which it could expand was necessarily limited. Then, too, the Cramp yard is among the oldest in the country, and the present arrangement represents a growth of many years, instead of a definite expansion along carefully predetermined lines, laid down when the plant was first built.

In consequence, changes in shops equipment had



Heavy and powerful tools, individual motor drives, floor plates and ample crane equipment characterize the new machine shops

to be carried out on the site of existing plant and additions made while the regular work of the yard was being carried forward. Even without considering the handicap that these conditions imposed, the improvements are impressive. Two new launching ways were put in and an older one extended. Four new overhead traveling cranes have been installed over the ways, said to have the longest span of any such cranes in this country. In addition, five revolving cranes of 90-ft. radius have been installed at the ways. The shop additions comprise a new ship shed, or fabricating shop, a new joiner shop, an electrical shop, a storehouse, a paint shop, a pipe shop, a power house, and several minor buildings. The ship shed has probably the most complete crane equipment of any fabricating shop in the country. A stockyard 150 x 600 ft. served by three gantry cranes has also been laid out. All told an investment of about $1,600,000 was involved in the improvements made.

The Newport News Shipbuilding & Drydock Company has made and has under contemplation improvements which call for the expenditure of about $800,000. These include the installation of an additional ship way, for which a large tract of land must be filled in, and a section of the water front dredged, the enlargement of the existing shipbuilding equipment and the extension of the shops. Improvements in the methods of doing work are here counted upon to play a considerable share in the increase of capacity of the yard.

Probably the most spectacular improvement, and the one involving the largest sum of money is that of the Sparrows Point, Md., yard of the Bethlehem Steel Company. The improvements here are being made in connection with vast extensions to the steel plant, formerly that of the Maryland Steel Company, and calling for approximately $50,000,000. The shipbuilding plant's share of this sum is stated to be about $4,000,000.

The most striking feature of the Sparrows Point yard is the character of the new buildings. This construction, as shown in some of the accompanying illustrations, represents the most advanced type of manufacturing building, and the structures will bear comparison with any in the country. The equipment is in keeping with the buildings. Liberal crane service has been furnished and every provision made for the expeditious and economical handling of work. Individual motor drive on all tools is a noteworthy feature. As a matter of interest, the interior of the old machine shop, which is being dismantled and its equipment moved to the new building, is shown in one of the illustrations. The great advance which has been made is clearly apparent from a comparison of the two interiors.

The type of machine shop that is being displaced by those of more modern character.

Among other improvements at this yard are the concrete launching ways. These have been evolved as a natural development of the desire to make the entire plant of the most permanent character, and it is probable that in due course all the slips will be provided with ways of this type. One of the illustrations shows a new slip which is not yet complete, with these concrete ways in the foreground.

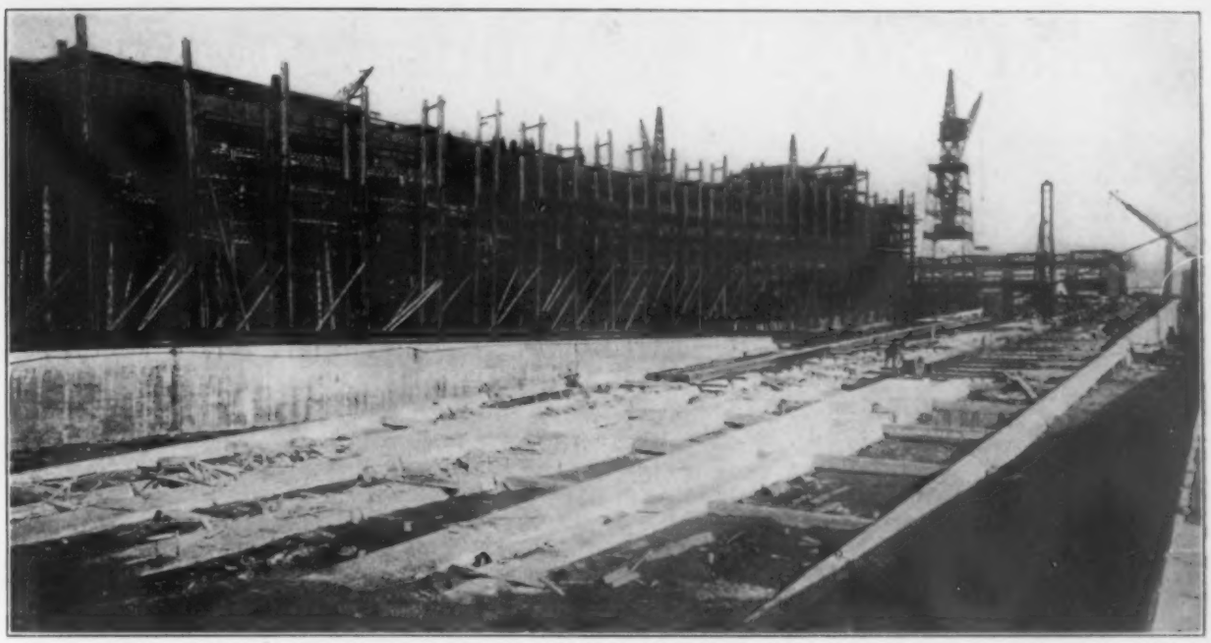
Not the least interesting feature of the Sparrows Point yard is its arrangement. The product of the fabricating shop is largely consumed in the hulls of the vessels on the ways. This shop, therefore, has been located across the head of the launching slips and immediately adjacent to them. On the side of the shop away from the slips is the stockyard, commanded by two sets of traveling cranes on parallel runways. Railroad tracks under these cranes permit the cars of raw material to be spotted and unloaded at the most convenient points, and the cranes classify and store the plates, shapes, etc., in their appropriate locations. When required in the shop the cranes load them on transfer cars, whose tracks extend transversely across the yard and fabricating shop, which brings the material within reach of the shop crane. The worked material is transferred on these same cars to a half-gantry crane which extends along the side of the fabricating shop and between it and the launching ways. This crane in turn places the material within reach of the traveling power cranes serving the launching ways. It is thus apparent that there is a minimum of handling of plates and shapes from the stockyard to their final position in the ship. The relation of the stockyard and fabricating shop is shown in one of the illustrations while the relative location of the same shop and the launching ways appears in another.

Similarly, the machine shop has been located so that it will deliver its product in as nearly a straight line as possible to the cranes on the fitting-out dock and to the 20,000-ton floating drydock which is to form a portion of the new equipment. The boiler shop and blacksmith shop have been located on either side of the machine shop, their products being required either in the machine shop or at the fitting-out dock. In every respect the yard bears witness to the application of the most advanced principles of industrial engineering.

What has been done at Sparrows Point is in a large measure true of other shipyards. Within their limitations of water front, geographical conditions and financial resources, they have taken advantage of the best that engineering science has had to offer them.

Improved Methods

Advantage also has been taken in the shipyards of the fact that frequently more work can be done in a shorter time by a change in the method of doing the work. One such change is the assembling of parts of the vessel on the ground or in the shop and their subsequent transfer to place in the ship as a complete unit. To within a few years all the structure of the vessel was assembled piece by piece in place in the hull. This was necessarily a slow process and was not always the most convenient method. Certain parts, such as sterns, bridges, bulkheads, deck structures, etc., can be much more easily built outside the ship than in it. This practice was initiated several years ago, but has been widely extended since the pressure on the shipyards has become intense. An instance of it is depicted in the initial illustration, which shows the



Concrete launching ways are taking the place of wooden ways at Sparrows Point. In the distance is the ship shed with the runway of the half gantry distributing crane in front of it

completed bridge of a collier being placed in position.

Similar changes have taken place in all departments of the yards and have resulted in no little saving of time.

Labor and Management

It is quite evident that the shipbuilding industry is fully alive to the opportunity that is at present before it. It is also evident that so far as plant is concerned it is and has been active in the steps necessary to meet the opportunity. The other side of the picture—that relating to labor—is not so bright.

The labor situation is frankly bad. Not only is labor scarce, but the almost unanimous opinion is that it is less efficient. As in other industries, it commands higher wages than it did at the beginning of the war, and it apparently renders less service for these wages than it did before that time. All, or practically all, of the shipyards have granted wage increases ranging from 10 to 30 per cent. The output per dollar of wage expenditure has decreased, as would be expected, but the output per man also seems to have suffered.

At two shipyards covered by THE IRON AGE'S inquiry the statement was made that an average of 24 per cent of the total pay roll was always absent from work. The explanation offered was that at the increased rate of wages, and notwithstanding the higher cost of living, the men were able to earn enough in three or four days to cover their needs for the week and that a certain percentage of them chose to be idle for a portion of the time rather than earn the extra money. At another yard progress charts of several vessels under construction were exhibited, showing that although a much greater number of riveters was employed than a year ago, the number of rivets driven was actually much lower. It is quite possible that in many cases improvements in method and extensions to plant may be almost, if not entirely, nullified by the labor situation.

The shipbuilding industry as a whole, does not seem to have taken any adequate steps to meet this problem. Other industries have found that the application of the principles of scientific management has operated to keep the efficiency of the labor force up to standard under practically all conditions of business. The shipyards apparently have not grasped the fact that these principles are as applicable to their work as to that of others. So far as we have been able to discover, but one yard has made any attempt to establish a really adequate routing system and to set piece rates based on time study. In this one case, too, the methods of routing and of time study are of the most rudimentary character, compared with what has been done elsewhere. Nowhere did there seem to be the slightest effort to set definite daily tasks for the men—a thing that is fundamental to the establishment of high labor efficiency.

Notwithstanding a generally expressed belief that the methods of scientific management would not work out successfully in shipbuilding, it is apparent to the management engineer that shipbuilding is in many respects a simpler proposition from the management standpoint than many other classes of work. Practically all the trades involved in shipbuilding have already come under the influence of these principles and the shipbuilders in applying them would already have had much of the preliminary work done for them. It is absolutely necessary for the shipyards to get in line on this subject if they are to put themselves on the soundest basis possible.

Standardization of Product

It is the commonly held opinion that American shipyards cannot compete with those abroad in normal times on account of the difference in labor cost; that is, the difference in the rate of wages. This is only partly true, and in the opinion of many shipbuilders is not the governing reason. Shipbuilding abroad, particularly in Great Britain, according to those who should know, has been reduced to a manufacturing basis, while in this country it bears more resemblance to a huge job-shop proposition.

The reason for this is that the British shipbuilder specializes on the type of vessel he builds. One yard will build only tug boats, another only oil tankers, a third bulk freighters, while others will specialize on passenger ships or war vessels. A yard will refuse to build a boat of a type on which it has not specialized. In consequence the British yard is able to make identical parts for a number of vessels

(*Continued on page 70.*)

Russia the Most Promising After-the-

Out of an Experience of Fifteen Years Country, C. Fraboni Points out the

C. FRABONI*

SINCE the war has been ravaging all Europe, the United States has begun to be interested in the great possibilities which the Russian Empire presents as an outlet for American products. The Government and leading banks and associations have published in the past year many pamphlets, booklets and reports about Russia, inciting the commercial and manufacturing companies in the United States to undertake a large trade with that country when peace again comes to Europe.

All kinds of facilities are being provided for this purpose. An American-Russian Chamber of Commerce was established in New York and a Russian-American Chamber of Commerce in Moscow. The National City Bank of New York is about to open a branch in Petrograd, and has a special Russian department in its offices at Wall Street, which, like the Department of Commerce at Washington, gives all kinds of information and statistics to anybody interested in that country. Already such activity has given hopeful results. Some large manufacturers sent their agents to Russia to study the market in relation to their products. Others began at once to ship those goods that were urgently needed, and at last the wiser and far-sighted manufacturers, knowing the great opportunities that country will open to them, are preparing a solid basis for a permanent and prosperous trade.

Being thoroughly acquainted with everything which concerns Russia, her inhabitants, customs, commerce and industry, I am glad to give some suggestions derived from my experience acquired by a sojourn of 15 years in that country. As secretary and manager of a large Belgian concern owning in Russia three important metallurgical plants, whose iron and steel products were sold through the whole territory to merchants as well as to the government, railroads, Zemstvos, etc., I happened to be in business and private relations with people belonging to different social classes, in commercial, industrial and official life, from the muzhik and little merchant to the highest functionaries of the empire, not only in the capitals and greatest cities, but also in the farthest villages.

The great activity, enterprise and energy of the Americans have raised the United States at the present time to the highest degree of commercial, industrial and financial efficiency, and it is growing day by day out of proportion to the needs of the country. It is evident that such excess of capital and production must necessarily find a large outlet abroad.

Before the war every one considered South America as the principal opening for exports; hardly any one thought of that vast empire going half-way around the globe and occupying one-sixth of its territory. The population of all the South American states taken together amounts to 50,000,000, while that of the Russian empire alone amounts to 170,000,000—that is to say, three times more. From three to four weeks are needed to reach Argentina or Brazil, while ten days are sufficient to reach Russia in normal times.

The revenue of Russia before the war was the largest of all the countries of the world, namely, $1,860,000,000, comparing with $1,600,000,000 in Germany, $1,100,000,000 in France and England, and $1,060,000,000 in the United States.

More than 179,000 miles of rivers, lakes and canals in Russian territory are navigable. The railroad system, which began to grow less than 50 years ago, to-day ranks next to the United States. In 1913 there were about 50,000 miles open to traffic, 12,000 miles in construction, and many more projected.

In the years following the conflict with Japan the internal economical situation in Russia improved greatly, as is shown by the deposits in private and state banks; whereas in 1908 these were $1,500,000,000, they were $3,000,000,000 in 1914. The imports of all kinds of products were about $350,000,000 in 1907; they had grown to $687,000,000 in 1913, with exports of $760,000,000, almost exclusively agricultural products.

Mistakes About Russia

As to the country itself, the knowledge of Russia possessed by the great majority of Americans was until recently about the same as that of Europeans 30 years ago. They gloomily thought of it as inhabited by barbarians, that the most horrible crimes were perpetrated there with impunity, that Cossacks and police were continually striking the peaceful people, and that the nihilists daily attempted the life of the Czar and his ministers.

It was believed there was eternal winter, not less than that at the North Pole. I remember having read many years ago in a small French paper, so-called correspondence from the then St. Petersburg, stating that the winter was so severe that year in Russia and so much snow had fallen that some hungry white bears entered the capital, where they were pursued and killed by a company of soldiers sent for their pursuit.

A few decades ago some engineers from France and Belgium went into south Russia to explore and locate the mineral wealth. Returning home they told of the immense deposits of coal and iron ore. Capitalists immediately organized to exploit those riches. They bought large estates where the mineral lay, opened shafts and built metallurgical works, sending their fellow countrymen there to occupy all kinds of positions, from managers and superintendents to workmen and boys. I remember it took a great deal to persuade those employees to accept their new positions in Russia, although salaries several times higher than they received at home were offered. A great number refused only from fear of that country, almost unknown to them. Those who accepted, being convinced they were going into a desert, brought with them all kinds of

*Mr. Fraboni, who was general manager in Russia for 15 years, of a large Belgian company producing iron and steel in Russia, has been in the United States for two years, and will return to Russia after the war.

War Market for American Products

in Iron and Steel Manufacture in that Lines of Procedure in Building up Trade

household implements, including brooms and rags with which to sweep and wash the floors. All were much surprised to find, instead of barbarism, a very kind, open-hearted and extremely hospitable people.

How Germany Pre-empted

Certainly we cannot put Russia on the same level with some other civilized nations. Lack of communication, autocratic form of government, intemperance, lack of education, and the immense extent of territory prevented the development and progress that put the other countries at the head of civilization. The needs of Russians have been limited, but when the immense population is considered the opportunity for profit is great. The nation which understood better such needs and profited more largely than any other was Germany, not only because of her geographical situation but because of her splendid commercial tactics.

England, France and the United States were always unwilling to yield to the methods of business followed in Russia, which are so different from their own. They did not want to quote in local currency and measurements, nor to quote goods with freights and duties paid; and above all, they never could condescend to grant the desired credits. Their attitude resulted in throwing all the trade with Russia almost entirely into the hands of Germany.

American consular officials who studied attentively the commercial situation in Russia, in their reports in the year preceding the war, already showed very clearly the situation and gave the following suggestions:

> Russia with Siberia presents one of the richest unexploited countries in the world; it is slowly changing from a purely agricultural to an agricultural and industrial country, and in this evolution foreign capital and foreign imports must play an all-important part. On the other hand, it cannot be repeated too often that Russia has business customs and commercial laws that are peculiarly its own; there is no country where knowledge of local conditions is more essential. Business success in Russia is largely dependent on the credit system, and knowing the persons to whom credit can be granted is possible only through local representation and a knowledge of local conditions. Success can be attained only by firms that are determined to establish business connections with Russia and are prepared to spend money on preliminary organizations.

Germany, after having studied thoroughly the country, realized that the only way to do large business there was to follow entirely the commercial customs and in some cases extravagances of that vast market. She sent numerous travelers, not only to the large centers, but also to the smallest and farthest places, providing them with full collections of samples and catalogues printed in local language, showing weights and dimensions in poods and arshines, and prices in rubles, including all expenses, in order to enable the smallest customer of the farthest village to buy German goods without any trouble.

Germany understood that since Russia was exclusively an agricultural territory, it was absolutely necessary to grant large credits, because the peasant has no money until he has sold his crops. Selling on credit, Germany did not take much risk, as it is shown by statistical reports, the percentage of unpaid debts in Russia being less than that of any other country.

Proceeding in this way, Germany invaded Russia with her products, selling at the same time the products of some other countries, including America, as her own. It is evident that these foreign goods left some profit to the German commission houses, although they had to pay different middlemen, steamship and railroad freights, insurance and many other kinds of expenses due to the entrance of those goods on German docks and their forwarding into Russia.

The American Opportunity

When the war is over the United States should maintain for some time its present place of the largest exporting nation in the world, and it is undoubted that the Russian market will be the greatest in capacity to absorb its products. Holding strongly the position given by the present unprecedented opportunity will depend entirely upon the capacity and ability of American manufacturers and financiers.

Russia herself, through her government, local papers, leading commercial and financial people, is extending now all kinds of solicitations to the United States in order to establish a closer bond of friendship, for reciprocal benefit, on the basis of the commercial treaty which existed since 1832 and terminated in 1911 by some racial misunderstanding.

If until now the limited needs of the Russian people have absorbed great quantities of foreign goods, what will the situation be when the war is over?

The Russian Peasant's Re-Birth

Certainly we cannot estimate the future of Russia from her past, because the present bloody struggle will raise that nation to the high spheres of progress and civilization. The first impulse has been already given in the curbing of intemperance. If Alexander II in 1863 freed the peasants from the squires, his grandson, Nicholas II., freed all the Russian people from their worst enemy—vodka.

Before the war workmen indiscriminately spent their last copeks for vodka, while now this money is saved and deposited in banks. The penniless peasant who during the long winter months lay almost all the time, and very often intoxicated, upon the large stove in the only room of his wretched hut, where his wife, his children and his cow slept together, now keeps busy in the rigorous season and tries to better his condition and that of his family. Formerly, he did not know what was happening outside of his village, but now, after having crossed thousands of miles of land, visited so many large cities and met thousands of people, he is transformed into an almost civilized man.

It is evident that the awakened mujik of tomorrow will want to put himself on the level of his fellows of the more cultivated nations. He will feel the necessity of living in more comfortable surroundings, of dressing better, and of eating better food; and he can have these things, having saved the money which formerly he spent for vodka.

This prosperity will increase gradually, because he will be able to make the most of his ground by fertilizing it, by employing appropriate machinery and by working it more intensively than he used to do. With the growth of prosperity, the spending capacity will also increase, and if we consider that the largest part of the Russian population is composed of mujiks, we can easily conceive the enormous quantity of all kinds of goods that will be needed to satisfy future demands.

Many products for housekeeping, building, wearing apparel, etc., before the war were manufactured in Poland, but now the plants making such goods no longer exist. All the other factories in Russia gave up their usual production and adapted themselves to making ammunitions and war supplies. This makes it evident that for a time importations will be in very large quantities, and that the country best able to supply the demand is the United States.

Attitude Toward Americans

The bold German dominion over Russian commerce has been followed naturally by a patriotic reaction, and there is now in Russia a strong sentiment in favor of supplying national needs with its own forces and resources. But this is a chimera.

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Such an ideal independence cannot be attained short of half a century and only by the assistance of some rich, powerful and progressive country like the United States.

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The Russian is very expansive, of good character, and a trustworthy fellow; but he is used to taking his time always, even in the most urgent affairs. To do successful business with him, either as a merchant, banker or official of the Government, it is necessary to be quite a good psychologist. You must divine his feeble points, talk with him upon his favorite subjects, drink together half a dozen glasses of tea, smoke a score of cigarettes, and at last, after he has told you all about his life and his family and you feel that he has become your friend, you may start to talk business. Further, if you manage to keep this friendship, your success is certain; you will be able to obtain from him any confidence and he will tell you frankly everything, also the propositions of your competitors in order to give preference to you.

Direct Representation

Only a few American manufacturers are in direct contact with Russia; the most of them market their goods in that territory by means of middlemen and commission houses. Such a way is very suitable for small manufacturers, who content themselves with relatively limited sales; but I do not think it is adapted to those greater enterprises which fill the largest orders.

Generally the commission houses buy similar products from different firms and sell all kinds of merchandise throughout the world; they are unable to pay special attention to any particular goods produced by a single manufactory. That method may do for countries where the amount of business does not permit keeping a special representative, but it cannot be recommended for a country like Russia with a population one and a half times that of the United States.

There is no doubt that a capable and active agent, representing directly one manufacturer or a small group of industries, correlated but not competitive, can develop the business of these firms vastly more advantageously than a commission house. In choosing the agent preference must be given so far as possible to an American or foreigner who has a good knowledge of the Russian language, customs and commerce, because it is not easy to find a native who is enterprising enough and has the activity and perspicacity so indispensable to successful business.

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Although the United States is farther away than any other competing country, many facts make us believe it will be possible to compete with any products required by Russia that have been drawn from other countries. There is a great opening for hardware and tools in general, for before the war 75 per cent of such goods were supplied by foreign manufacturers and almost exclusively by Germany.

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Representatives of American firms must not limit their activity to European Russia only, but should go into the adjacent territories which, being practically without manufacturing industries, offer

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For ten years the Russian government has encouraged immigration to Siberia, placing millions of acres at the disposal of peasants who wished to go there, and supplying them with agricultural machinery and tools. Such a policy gave good results inasmuch as the population increased by many millions and the production grew 150 per cent.

From the eastern side of Siberia it is easy to extend the trade into Manchuria and some Chinese provinces. The Chamber of Commerce at Vladivostok is insistently asking for catalogs and samples from America.

The Caucasus and Central Asia also present good commercial opportunities; they are, moreover, a practical way of transit for a Persian trade.

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Working Through Sub-Agents

The Russian empire is so immense and the means of communication so limited that it is quite impossible to conduct from a single office a large and efficient trade in the whole territory. The best result may be obtained by appointing some sub-agents in the principal centers and by giving them as their territory the few surrounding provinces. Many old and well reputed firms in the largest towns of Russia work as sub-agents for large concerns; they keep a certain number of salesmen who are continually visiting all the clients of their district.

From 15 to 20 of these sub-agencies are necessary in order to cover the field. These firms, having been established for many years, know thoroughly trade in their region, the solvency of each merchant and his buying power, and are constantly in contact with him. They receive a commission in accordance with the kind of goods they sell and the quantity that eventually can be put on the market, and many of them guarantee for a certain amount the integrity of all payments.

It is very important for the representative of American manufacturers to make the acquaintance of all his presumed future clients, large and small, in the greatest cities as well as in the farthest villages. This should be done shortly after his arrival in Russia by a detailed journey through the whole country, preferably with a sub-agent for each district. This will give a good idea of the market in general and particularly of the special goods which are to be introduced, and will lead to a better footing.

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The representative will find a useful aid in the Russian-American Chamber of Commerce and also in the so-called bourses. About 100 bourses operate in the principal centers of the empire, but they differ from those existing in other nations, being composed exclusively of members belonging to the commercial and industrial world. These members in the assemblies discuss the needs and interests of the local trade and name committees to settle

Russia has nearly 3½ times the population of all the South American countries.

It is reached in normal times in ten days; Argentina in three to four weeks.

Russia's revenue before the war was the largest of all the countries of the world.

In 1913 Russia had 50,000 miles of railroad open to traffic, 12,000 miles in construction and more projected.

Much will come from the awakening of the peasant, who has become thrifty since the prohibition of the use of vodka.

questions of commercial law, imports, exports, quotations, arbitrations and various economic and technical issues.

The bourses have their exchange brokers and notaries; they maintain special bureaus for railroad and navigation freights, have departments for different branches of trade and control the importation and exportation of various products. The government and many private institutions invite the representatives of the bourses to participate in meetings and conferences where commercial and industrial questions of national importance must be solved.

Credits and Banking

Long credits, which are so important in Russian business, are facilitated by the local bank institutions. There are in Russia, besides the state and land banks, five or six large private banks which have numerous branches throughout all the country. Each of these banks has a capital of from 20 million to 60 million rubles and deposits of 200 million to 500 million rubles. These institutions take an active part in commercial and industrial life and are willing to give all financial facilities in order to develop the Russian trade.

The co-operative banks have also attained an important position in the financial world. In the last decade the number of such banks has increased remarkably. There are now about 12,000 of them and they render valuable service to the small merchants, especially in distant country places. Great assistance to American manufacturers doing business in Russia would be given by the establishment of Russian-American banking institutions.

The war will be followed by a tremendous need of all kinds of works for the public welfare. Before the actual struggle the greater parts of such works, as railroads, tramways, electric light, etc., were managed by foreign companies, especially Belgian and French. These people will not be in a position now to undertake such new enterprises in that country and the way is thus open to Americans.

Early Attempts in Iron Making

Russia has immense mineral resources, but only a small part has been developed and almost exclusively by foreigners. Lands containing coal, iron ore, copper, mercury, silver, gold, etc., can be acquired at a relatively low price and their exploitation by active and able American engineers should give excellent results.

The mining and metallurgy of Russia began to be developed only at the end of the last century. When Peter the Great undertook his long journey through the country, the Cossacks of the Donetz showed him as a curiosity a piece of coal, saying they found such black stone almost on the surface of the ground and that they used is as a fuel in their huts.

Afterward, in the beginning of the eighteenth century, the government started to exploit the mineral riches of the Donetz basin, and for this purpose it built at Lugansk a foundry and furnace, intending to supply both fuel and iron for the needs of the Black Sea fleet. This first Russian furnace never produced a single pound of iron because there were not people able to direct such an enterprise. This failure delayed for 50 years the development of metallurgy in Russia. A second iron works was built in 1845 at Kertch, on the Black Sea, but it was ravaged by the allied armies during the Crimean war. Persisting in its design, the government constructed for the third time a large plant named Petrovsky, in honor of Peter the Great, but after casting a few tons of pig iron this plant also was compelled to discontinue production because of the inefficiency of the furnace. A fourth plant was built at Lisichansky, but without any better success—this time for lack of coke and because of the tremendous expense in transportation of raw materials.

Success to an Englishman

After all these failures the government had recourse to the grant system, giving the concession to the Prince Kotchubei to build in South Russia a large works for a production of 7,000 tons of rails per year, with a prize of 50 copeks ($.25) for every pood (36 lb.) produced in the first five years. In spite of this enormous subsidy and an assured sale, the Prince Kotchubei was unable to find enough money for such an enterprise, and at last was obliged to cede his concession for £24,000 to an Englishman, John Hughes. This brave and energetic man formed in London the New-Russian Iron Company for the production of rails, iron and coal, with a capital of £300,000.

Mr. Hughes signed a contract with the Russian government by which the latter ceded to the company all the ground needed for the digging of mines, construction of factories, living of working people, etc., and at the same time a subsidy of 50 copeks for ten years was given for every pood of iron produced.

The difficulties of all kinds Mr. Hughes encountered were tremendous. He did not know the language or the customs and habits of the country, which looked at that time like a desert. He found himself in the midst of unfavorable economic conditions and in the way of creating a large industrial enterprise with a very problematical future, if one should judge by the experience acquired by the Russian government at an expenditure of many millions.

That locality was then a broad steppe without inhabitants. All machinery and materials had to be sent from England to Taganrog by boats, and from Taganrog to destination, pulled by oxen over a roadless ground, mud covered and almost impassable. By the same way, too, came all the workmen and engineers. Jan. 24, 1872, the day on which the New-Russian Iron Company began to produce iron, marks also the epoch of the industrial development in Russia. The concern named, which is still one of the largest and richest of the country, set the example and led to the foundation of many other mining and metallurgic enterprises, but always with foreign capital.

There are steel and other products which are not yet manufactured in Russia, or only in a very primitive way. Thus plenty of profitable opportunities are open for the establishment of new industries or for the development of those already existing, by sending American specialists there.

Belgian and French Promotion

In 1910 prominent Belgian and French interests having large enterprises in South Russia formed at Brussels a company called Société d'Etudes des Entreprises Russes (Society for the Study of Russian Enterprises). The members of this company were exclusively people belonging to various industrial branches, who had been living in Russia many years as directors, managers and engineers of large manufactories and had a thorough knowledge of the commercial and industrial life. The duties of the members consisted of indicating to the company,

(*Continued on page* 71)

Fig. 1 — A 6-In. Round Cast-Steel Ingot, Split Down the Middle, Showing the Extent of the Pipe

Shell Manufacture From Cast Steel

Successful Practice Developed by the American Steel Foundries — Hot Tops and Small Pipes

BY EDWIN F. CONE

MILITARY preparedness in the United States has received a great impetus as a result of the war. Very few realize the extent of it. This is particularly true of the production of shells in all its branches. The manufacture of steel shells has followed several lines—those made from steel rounds rolled from ingots or billets, those forged from blooms and billets, and those made from cast-steel ingots direct. The last method has assumed considerable proportions in this country in the past year. A conservative estimate places the present production, mostly by steel foundries, at about 25,000 tons per month. In the development of this business, the American Steel Foundries of Chicago has had an important part and its success has been noteworthy.

The manufacture of high explosive steel shells presents many problems. Producers not skilled in the business have had much to learn and have suffered by some serious losses. Besides this, the inspection by foreign governments is extremely severe, necessitating in many establishments radical changes in ingot production. In the case of steel rounds or billets for shells the elimination of segregation, secondary and other pipes, and surface defects has been a serious problem. The same problems enter into the production of cast-steel shell blanks. No such defects, even the smallest, are allowed to pass the inspectors. The static specifications are also generally drastic. A significant result of the solution of many of these problems has been the production of a sounder steel.

The pouring of ingots for shells presents an attractive proposition to the average steel foundry, be it basic or acid. In most foundries the melting capacity is not a little in excess of the molding or floor capacity. Even when operating at capacity, the furnaces can produce more metal than the molding department can furnish molds to take. The opportunity, therefore, to increase output and not greatly to burden the foundry itself has been welcomed by steel foundrymen.

The American Steel Foundries has nine large plants located between Philadelphia and St. Louis. Late in 1915, at one of its plants in Western Pennsylvania, the company started the production of small shells on a large order. It called for round ingots for 4.5-in. shells and it was these the company first produced. It is now making 6-in., 8-in., and 9.2-in. round ingots.

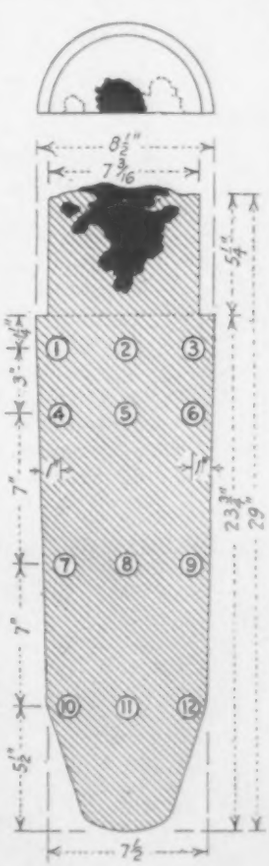


Fig. 2—Diagram of an 8-In. Cast-Steel Ingot Showing Location of the Drill Holes Representing the Analyses for Segregation Given in the Table on the Next Page

Special Problems

The problems connected with the production of such small ingots, while similar to those for large ingots, are yet different. While the large ingots are later rolled down into billets and rounds or forged down direct, the small shell ingots are at once transformed into shells with relatively little working or machining. The three principal problems involved are:

Elimination of pipes.
Elimination of segregation.
Avoidance of surface defects.

The vital factor in the elimination of pipes has been found to be the use of the hot top with the iron mold. This top consists of a sand cup or basin, similar to that used for pouring steel molds, and reinforced with an iron rod. It has been found superior to and cheaper than any brick or refractory hot top. By the use of this and the addition of a small amount of charcoal on top of the metal as soon as poured the main pipe has been entirely brought out of the main ingot.

But practically the entire elimination of all pipes has been found possible only when the height of the ingot is that necessary to afford one shell blank. In the first shells made, ingots were cast long enough so that when cut in two, two shell blanks resulted. But while the main pipe was eliminated, as indicated above, there was a suggestion of a slight secondary pipe in the lower shell blank. The government inspecting these shells finally decided that the safest method was to pour ingots only one shell blank high and this is at present the practice in all the various sized shells the company makes.

An indication of the success of this method is shown by one of the illustrations revealing one-half of a split 6-in. round ingot, Fig. 1. The pipe is shown to be almost entirely in the area covered by the hot top, and the fracture of the metal is excellent from bottom to top.

Elimination of Segregation

The elimination of segregation is, of course, a corollary of the elimination of the piping; while the use of charcoal tends to raise the carbon in the upper part of the discard, on the whole segregation of all elements has been successfully eliminated in the main shell ingot. This is demonstrated by the following table of chemical analyses of the drill-

Fig. 3—The Later Form of 8-In. Cast-Steel Ingot with the Nose End Split and Showing Extent of the Pipe

Fig. 4—Rows of Iron Molds Ready for Pouring Cast-Steel 8-In. Shell Ingots at One of the Plants of the American Steel Foundries. The refractory hot top is clearly shown on each mold. These are the molds for the nose ingots

ings from 12 different holes on the surface of a split 8-in. round ingot.

Analyses of a Cast Steel 8-In. Ingot To Show Segregation

Drill Hole	Carbon, Per Cent	Manganese, Per Cent	Silicon, Per Cent	Phosphorus, Per Cent	Sulphur, Per Cent
1	0.465	0.81	0.292	0.015	0.024
2	0.465	0.82	0.300	0.016	0.023
3	0.476	0.83	0.286	0.017	0.024
4	0.474	0.82	0.290	0.016	0.024
5	0.468	0.82	0.296	0.015	0.024
6	0.456	0.83	0.290	0.016	0.025
7	0.471	0.83	0.282	0.014	0.024
8	0.437	0.80	0.290	0.015	0.022
9	0.435	0.81	0.296	0.014	0.024
10	0.476	0.82	0.290	0.014	0.024
11	0.441	0.81	0.300	0.014	0.025
12	0.471	0.83	0.290	0.015	0.025

The variation in carbon, manganese, sulphur and phosphorus is very slight. The location of the holes is shown by one of the drawings, Fig. 2.

Surface Defects and the Mold

The avoidance of surface defects is largely bound up in the problem of the mold and its wash. All shell ingots made by the American Steel Foundries are made in cast-iron molds. Early in the investigation of this subject the Gathmann mold was used. This made shell ingots two blanks high. Besides the defect of a slight secondary pipe referred to above, the thinness of the wall of the upper portion of the mold intensified this tendency. When the one-high shell blank mold was ordered, this tendency was entirely overcome.

The successful mold has been found to be the iron mold about 2½ in. thick. The iron for the molds must contain about 1 per cent silicon, with the other ingredients normal. A Bessemer iron was originally ordered with a view to using the scrapped molds in the place of Bessemer pig iron, but these were hard to secure. The successful molds have averaged about 3.75 to 4 per cent total carbon, about 1 per cent silicon, about 0.40 to 0.50 per cent manganese, about 0.12 to 0.15 per cent phosphorus, and about 0.020 per cent sulphur. These last on an average of about 150 to 160 heats. Their durability is influenced by the length of time the hot ingot is left in the mold.

An important influence on the surface defects in the final ingots is the use of a wash for the molds. The absence of any has a deleterious influence because of a splashing of the steel on the inside, which often results in defects. Too much wash, whether graphite or silica, is also not to be recommended. A successful practice is the use of a very thin coating of graphite wash. Ingots so poured from the top have very few surface defects.

Another consideration is the avoidance of fins at the top and bottom of the straight-walled ingots.

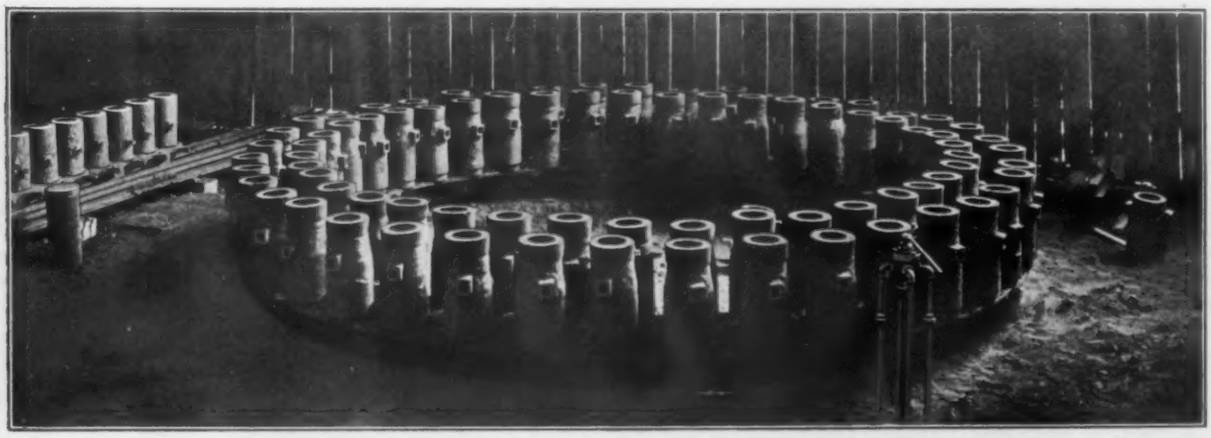


Fig. 5—A Revolving Table Containing Iron Molds for Cast Steel 4.5-In. Shell Ingots at One of the Plants of the American Steel Foundries. This method eliminates the necessity of moving the large ladle to pour each mold

Where cylindrical molds with no bottom are used, they are placed on a close-fitting stool. The hot top is so made that it has an offset on the lower side extending slightly into the mold, preventing a fin at the top. Fins usually result in a crack in the ingot. Fig. 7 illustrates this point.

Most of the shell ingots made by this company in the past year have been of the straight-walled type. As will be indicated later, there has been some objection to these in forging them because of the sharp edges at the bottom. In making recent 8-in. and 9.2-in. ingots, a new type has been adopted as shown by Fig. 3. It has a tapered wall 8½ in. at the top, 7½ in. at the bottom, with a nose end. This is top-poured wide end up with hot top and charcoal, as in all other cases. The extent of segregation in this ingot has been referred to.

To cut down the expense of the use of iron molds, experiments were made using green and dry sand molds. They were unsuccessful. Despite the hot top and every precaution, pipes resulted extending well down into the ingot. Fig. 8 shows how these ingots looked after splitting.

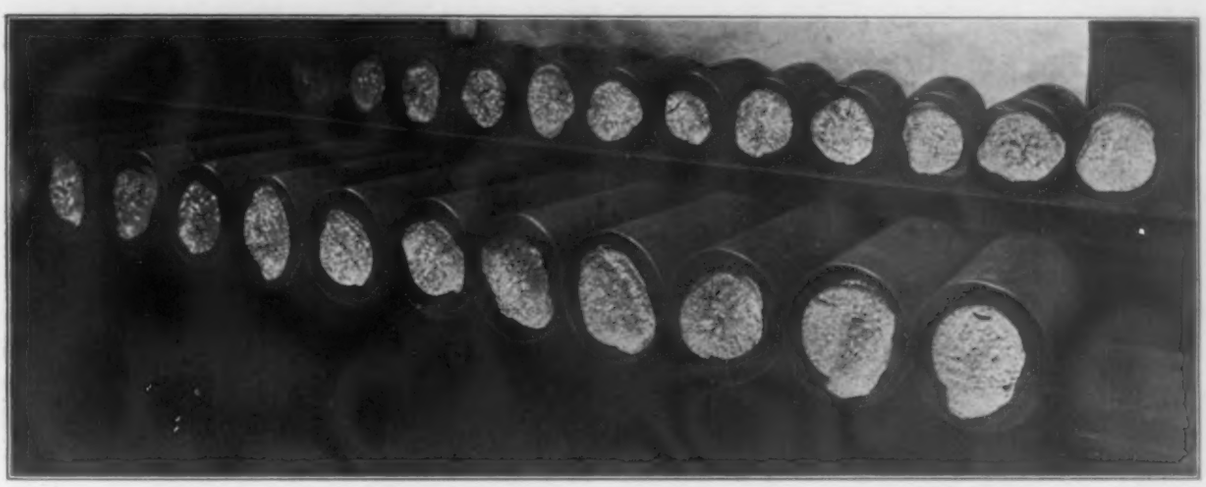


Fig. 6—Rows of Cropped 8-In. and 6-In. Cast-Steel Shell Ingots Made by the American Steel Foundries, Showing the Fracture. It is in this form that they are inspected for pipes. These are the straight cylindrical ingots

Cropping and Inspection

Compared with the molding, cleaning, annealing and inspection of the average steel casting, this ingot proposition is simple. Soon after pouring, and while still at a cherry red, the ingots are shaken out. The natural contraction makes this simple. As soon as cool enough, they are removed a short distance to large friction saws. Here they are placed in a revolving mechanism, where they are rotated while they are being nicked with the saw, a distance of about an inch into the ingot and about 2 or 3 in. from the top below the sinkhead, or enough to insure a crop of 20 to 21 per cent.

The removal of this metal by a drop offers a fracture of the ingot comprising about 80 per cent of its area and affording ample surface for inspection for pipes and porosity. Only one-sixth of the area in the crop is demanded by the specifications. The fractured ingots roll upon a table, where they are chipped for surface defects, and finally inspected by government inspectors before final shipment to the forge shop. This inspection is urged by the company to be as severe as possible, so as to avoid further losses. Fig. 6 shows rows of these cropped ingots of various sizes ready for inspection. Fig. 4 represents rows of molds of various sizes ready to be poured in front of the battery of basic open-hearth furnaces. For pouring the small ingots a revolving table is used, for greater speed and less loss of metal results than in moving the large bottom pour ladle from one mold to another. Fig. 5 gives a view of this operation. At the plant referred to, five 25-ton basic open-hearth furnaces are engaged in pouring nothing but these shell ingots of various sizes.

Testing the Quality of the Steel

Severe physical or static specifications must be met before the finished shells are finally accepted. That is, after the ingots or blanks have been converted into shells, representative tests are made of the metal. To guard against ultimate rejection there, the company at its place of manufacture casts representative ingots which it forges down into a bar 1¾ in. in diameter. After these bars are heat treated, or annealed, similar to the final method at the forge shop, they are turned down to 0.564-in. diameter and tested. The results so obtained afford a check on the final acceptance of the heat. Representative tests of this nature are given below:

Physical Tests from Test Ingots for Shell Forging Ingots Made from Basic Open-Hearth Cast Steel

Description	Serial	Elastic Limit, Gross Tons Per Sq. In.	Tensile Strength Gross Tons Per Sq. In.	Elongation, in 2 In.	Carbon, Per Cent	Manganese, Per Cent	Silicon, Per Cent	Phosphorus, Per Cent	Sulphur, Per Cent
Nose test	1	23.32	37.02	26.6					
Base test	1	23.59	37.57	26.0	0.419	0.60	0.26	0.015	0.029
Nose test	1	23.41	37.52	25.5					
Nose test	2	24.07	40.15	25.5					
Base test	2	24.70	39.65	24.0	0.463	0.63	0.24	0.018	0.027
Nose test	2	24.07	39.83	25.0					
Base test	3	25.71	41.91	23.0					
Nose test	3	25.55	41.15	24.0	0.486	0.70	0.26	0.026	0.021
Base test	3	25.91	42.03	23.5					
Nose test	4	26.48	42.43	22.0					
Base test	4	26.41	42.94	22.0	0.510	0.66	0.29	0.024	0.024
Nose test	4	26.30	42.42	23.0					
Nose test	5	28.34	45.12	20.0	0.524	0.76	0.30	0.018	0.023
Base test	5	27.24	44.87	21.0					

Chemical and Physical Specifications

The specifications require a yield point of 19 gross tons per sq. in., a tensile strength of 35 to 49 tons per sq. in., and an elongation of not less than 19 per cent in 2 in. on a diameter of 0.564 in. It is thus seen that the foregoing preliminary test more than fully meet these requirements. If, however, in the final tests at the shell-forging plant the tensile strength exceed the 49 tons, the heat is rejected, even though the other requirements are completely met. The severest inspection is the meeting of the static requirements after forging, etc.

The chemical specifications are not severe, and offer considerable latitude. While the carbon speci-

fied is 0.30 to 0.55 per cent, it is found that 0.40 to 0.55 per cent is the range desired. A minimum of 0.40 per cent manganese is called for, but 0.65 to 0.75 per cent is aimed at. The silicon must be under 0.30 per cent, with the sulphur and phosphorus normal for basic steel.

The shell blanks are shipped weighing about 52 lb. each for the 4.5-in. shells, about 150 lb. for the 6-in., about 275 lb. for the 8-in. and about 367 lb. for the 9.2-in.

Forging and Finishing the Shells

At the forge shops the blanks have a corresponding steel die, the shape of the finished shell, into which they are dropped after being heated to about 2100 to 2150 deg. Fahr. They closely fit this die. A hydraulic ram hits one end of the ingot and forces it into the die until the hot steel completely fills the space. As soon as the hot steel has filled the die, a piercing ram is forced in, forming the hollow part of the shell, the excess metal oozing out at the back. The walls at this stage are about 1½ to 1¾ in. thick. Fig. 9 shows the foregoing operation in each stage.

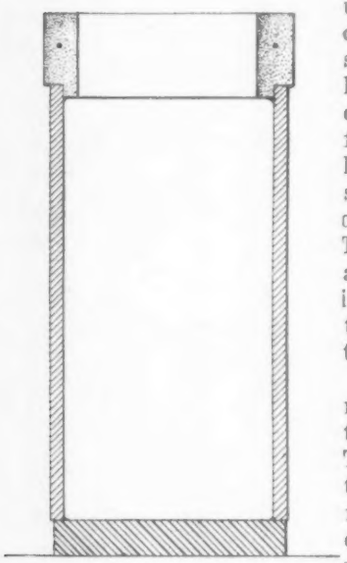


Fig. 7.—Diagram of the Application and Shape of the Hot Top with Its Offset Extending Into the Mold to Prevent Fins. It rests on an iron stool

It is from this metal that the final test pieces are cut. These rough shells are then annealed and machined inside and out to the proper dimensions, about ¾ in. coming off the outside and about ½ in. from the inside.

In forcing the ingots, cast in straight cylindrical molds, into the dies, it has been found that the sharp edge at the bottom injures the die before long. To overcome this, the straight ingots have been cast with a curved edge at the bottom, formed by a solid mold which has a curve on the outside edge formed by a ¼ in. radius. A still better method is the one already referred to and lately adopted—the tapering ingot cast with the nose end and wide end up, as shown by Fig. 3.

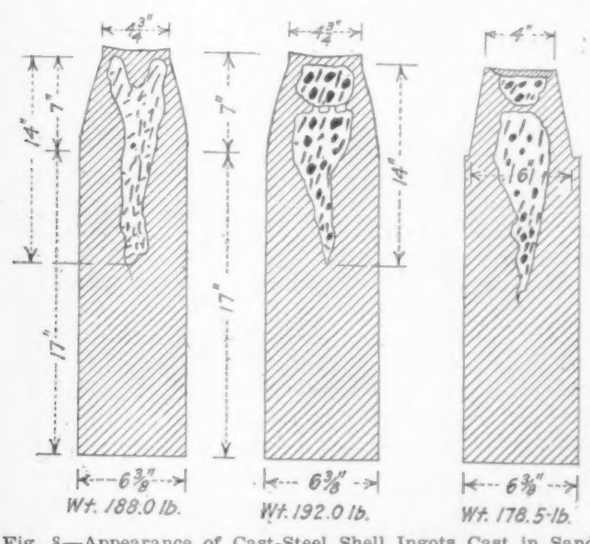


Fig. 8—Appearance of Cast-Steel Shell Ingots Cast in Sand Instead of Iron Molds. Even with hot tops the pipe was extensive

Relative Merits of Different Processes

The question of the relative merits of shells made from steel rounds or from cast steel blanks has received some attention, and it is claimed that in the case of tranverse physical tests—those taken crosswise to the axis of the round—the cast round or blank is quite superior to the rolled round. It is also claimed that cast shell ingots of basic steel are superior statically to those of acid steel. The company produces both basic and acid shell ingots. It has been especially noted that the basic ingot machines are better than the acid ingot of the same composition.

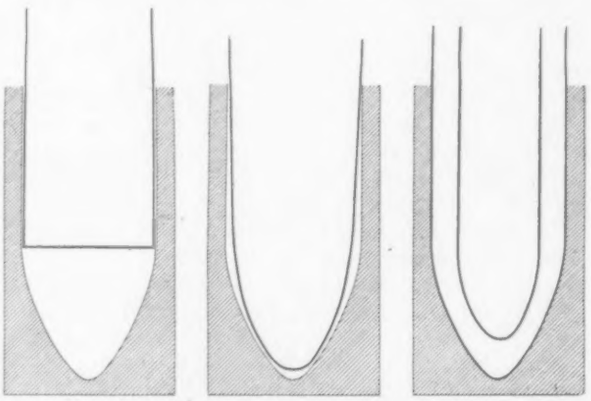


Fig. 9—The Various Stages in Transforming the Rough Ingot Into Shells. The square or nose end ingot is rammed by great pressure into steel dies, shaped like a shell and then pierced with a piercing ram, forcing the excess metal out

Before the war the production of cast steel shells was not large in the United States. There was but one plant devoted almost entirely to this class of work. Nor was the experience in making shells from steel rounds rolled from steel ingots extensive. Many foundries in the United States are now engaged in this important work, and the number is growing constantly. While military preparedness has been one important result of the war, most significant and striking are the metallurgical developments. As the story unfolds, it will be found that the far-reaching advances toward sound steel have been the most vital achievement as related to the steel industry.

Purchase of Fairbanks Power Hammer Business

The United Hammer Company, 141 Milk Street, Boston, Mass., has purchased the power hammer business of E. & T. Fairbanks & Co., St. Johnsbury, Vt. These hammers were first placed on the market in 1890 by the Dupont Mfg. Company, St. Johnsbury, the owner of the original patent. In 1902 the business was taken over by E. & T. Fairbanks & Co., and the trade name changed from Dupont to Fairbanks. The trade name of the hammers, which are of the belt-driven type, will not be changed. An illustrated description of the hammer appeared in THE IRON AGE, April 10, 1913.

More than two-thirds of the world's supply of tin is mined in the Malay Peninsula, and Straits tin, as it is known, is of exceptionally good quality, being 99.9 per cent pure. The total exportation from Malay in 1913 was valued at $47,492,845 and in 1914 at $34,460,128. The direct shipments to the United States in 1913 were valued at $13,295,674, in 1914 at $8,726,076, and in 1915 at $17,991,042. The tendency is toward an increase in direct shipments to the United States, according to U. S. Consul Harry Campbell of Singapore.

Waste-Heat Boilers Make Good Record

Experimental Battery of Fire-Tube Boilers at South Chicago to Be Augmented by Large Installation—Description of the Boiler

NEARLY a year of operating service has been completed since the installation of three fire-tube waste-heat boilers at furnaces Nos. 1, 2 and 3 of the No. 1 open-hearth department at the South Works, Illinois Steel Company. Now eleven additional boilers of the same type, with such modifications as larger furnaces, different space limitations and certain improvements in construction features have dictated, will be installed at the No. 2 open-hearth department. Three furnaces of this battery of fourteen had been previously equipped with water-tube waste-heat boilers. The larger use of the fire-tube boiler for this purpose, following in direct sequence the experience with the experimental battery of three, gives to a description of this type of waste-heat boiler a special interest.

The Type of Boiler

This boiler consists of two or more cylindrical shells, usually in a vertical or slightly inclined position, through which the waste gases pass in series. Each shell contains tube sheets into which are expanded a large number of fire tubes of diameter and length to suit the space available and the evaporative capacity required. In the usual construction the boiler has only two shells or passes. The waste gases enter the gas box at the bottom of the first pass, whence they are directed upward through the tubes into the upper gas box. A transfer flue leads the gases to the top of the second shell, through which they flow downward and pass from the bottom to the stack.

The steam drum is a horizontal or vertical cylindrical shell located beside the two boiler shells and above the upper tube sheets, so that the latter are always submerged. When space does not admit of an independent steam drum it is omitted and the tubes and shells lengthened to allow steam space in the upper portions of the main boiler shells. The feed water is admitted at the bottom of the second pass, where it is gradually heated, the gases at that point having a low temperature of 400 to 500 deg. The greater portion of scale forming compounds in the water are thus precipitated where the gas temperatures are lowest, and where the sludge may be readily blown out through the several blow-off connections. On account of the low gas temperature the tendency of these precipitates to form a hard scale is minimized. An exterior water circulating pipe of large diameter connects from the second pass near the water level to the bottom of the first pass.

Since the water evaporated in the first pass must come from the upper part of the second pass, only a portion of the scale-forming compounds can reach the first pass, where approximately three-quarters of the evaporation takes place. Only one-quarter of the heat is transmitted in the second pass, and as most of this is utilized in heating feed water the circulation will not be active and the sludge remains in the bottom of the pass, where it may be blown out at intervals.

The gas boxes at top and bottom of the passes are provided with cleaning doors for removal of the dust when the boiler is out of service. When in service the tubes are blown by rotating steam soot blowers permanently installed over the upper tube sheets.

Certain conditions of service, now commonly recognized as the result of experiences with waste-heat boilers of various types operating in connection with open-hearth furnaces, are required to be met. It is of importance to mention them, for the reason that the design and the construction of the Bacon boiler have as their particular objective the meeting of these several requirements. This is, of course, to be expected of a special type boiler in greater degree than of an adapted type of boiler which otherwise is standard for service of quite different character. They are: (1.) Infiltration of air. (2.) Dirt accumulations from the waste gases. (3.) High velocity of gases in the boiler. (4.) Limited space for installation. (5.) Low primary and maintenance costs.

The Matter of Air Infiltration

Foremost among these conditions is the requirement of the regenerative type of furnace, that a considerable induced draft be maintained in the gas flues leading therefrom, in order that the gases may be drawn through the tortuous passages of the regenerative chambers, which contain the usual brick checkers, obstructing the flow.

The draft thus required at the inlet of the boiler frequently is 1½ in. of water or more, and increases to 4 or 5 in. at the boiler outlet, due to friction through the boiler. Because of this high draft the air leakage through the brick settings of water-tube boilers results in a considerable loss of efficiency of the boilers themselves and materially increases the power required for driving the induced draft fans. The most attentive efforts toward keeping the setting tight are only partly successful.

Explosions in the waste-gas flues are characteristic of open-hearth furnaces using preheated gas, and are due to the escape of gas into the flues at the time of reversing the gas valves. These explosions are exceedingly troublesome in loosening the brickwork of the water-tube boiler settings, thereby increasing the air leakage and involving a high expense for repairs. To meet these difficulties the Bacon boiler, in contrast to the water-tube boiler with its brick setting, is a fire-tube unit with the water and steam space enclosed in a cylindrical steel shell.

Fine Dust Accumulations

The dust coming from open-hearth furnaces and checker chambers is so fine and adherent that it packs closely on all objects in its path. In the fire-tube type the dust does not readily collect on the surface of the tubes, especially when the tubes are in vertical position, since the gases pass through the smooth tubes at a velocity as great as 80 ft. per second. A small amount of dust collects on the tube sheets and other surfaces against which the gases impinge, but in such locations may be easily removed.

In the fire-tube type of boiler the straight tubes may be effectively blown while the boiler is in operation by permanent steam nozzles, so arranged that steam jets may be directed through the tubes by

a few manipulations of exterior valves and levers. This prevents air leakage and at the same time gives an effective sweeping action through the tubes. Cleaning the dust from water-tube boilers requires considerable time each day, is not wholly effective and allows large amounts of air to enter the setting through the cleaning doors through which the blowing pipes are inserted.

Cleaning water-tube boilers while out of service can be done only by allowing the boilers to cool sufficiently for the workmen to enter the setting and brush the tubes with brooms, removing the dust from the various recesses by shoveling it out through the cleaning doors. In the fire-tube type the tubes that are not kept clean by means of steam jets may be brushed out with wire brushes on long handles. Similarly, the dirt collecting in the gas boxes and other spaces is removed by brushes and other tools without the necessity of cooling off the boiler.

In a paper presented at the December meeting of the American Society of Mechanical Engineers by Arthur D. Pratt, it was stated (see page 1425 of THE IRON AGE of Dec. 21, 1916), with reference to water-tube types of waste-heat boilers:

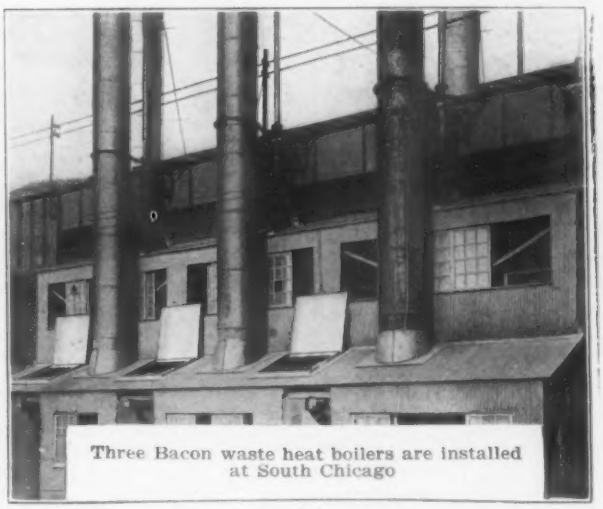
"In practically all plants now operating waste-heat boilers in connection with open-hearth furnaces, the boilers are dusted once in 24 hr. In one plant which operates 11 such boilers and in which the results are checked perhaps more closely than in the average steel plant, the engineers have concluded as the result of actual experience that it pays to dust every 8 hr. shift. In a certain plant a series of tests were run with cleaning intervals of 20, 10 and 6 hr. When the boiler was allowed to go 20 hr. without cleaning, the reduction in gas temperatures at exit after cleaning was 60 deg. Fahr.; where the cleaning intervals were 10 hr., 50 deg., and where 6-hr. intervals elapsed, the reduction varied from 10 to 30 deg. Fahr. In a second plant, with large boilers, after an undusted period of 24 hr., for an unchanged entering temperature, the exit temperature was reduced 35 deg. by a thorough cleaning. In this instance, with the gas weight passing through the boiler, this 35-deg. reduction was equivalent to an increase of 22 hp. This increase in capacity would not, of course, hold over a period of 24 hr., but it would appear conservative to state that the 24-hr. cleanings for such conditions would correspond to at least a net saving of 10-hp. as against 48-hr. cleanings. At $40 a year per horsepower—a rough estimate of the yearly value—this would mean an annual saving of $400 per boiler."

This reference to the dirty character of waste gas not only points to the more efficient transfer of heat in a boiler where the dust accumulates less readily, but suggests an additional saving in cost for labor and time out of service required in the cleaning operation, especially when provision is made for mechanical rather than manual cleaning.

Available space for boilers in existing open hearth plants is, as a rule, exceedingly limited. The Bacon type of fire-tube boiler has a form of construction that is flexible as to diameter and length, and may be used in horizontal, vertical or inclined position. Moreover, it may be used as a single boiler, or divided into a number of smaller sections or "passes" through which the gas may flow in series or parallel. This flexible construction favors the efficient arrangement of the heating surface. In many instances the cubical space required for the fire-tube boiler will not exceed, it is found, two-thirds of that necessary for the usual type of water-tube boiler.

Results of Tests of Waste Heat Boilers

Test number	1	2	3
Plant	Illinois Steel Co.	Indiana Steel Co.	Illinois Steel Co.
Location	South Chicago	Gary, Ind.	South Chicago
Rated capacity of furnace, tons	65	75	45
Actual production, tons	72	85	55
Boiler	Stirling	Rust	Bacon fire tube
Heating surface, sq. ft.	4,000	4,880	5,670 total: 4,400 submerged
Superheat, deg. Fahr.	128	176	266
Gas weight, lb. per hr.	73,000	83,434	50,700
Gas per hr. per sq. ft. of h. s., lb.	18.3	17.1	8.9
Temperatures:			
Gas entering boiler, deg. Fahr.	1,227	1,155	1,295
Gas leaving boiler, deg. Fahr.	621	530	523
Drop in temp., deg. Fahr.	606	625	772
Draft at boiler inlet, in.	....	1.47	1.18
Draft at boiler damper, in.	....	3.95	2.18
Draft loss, in.	1.78	2.48	1.00
Gross hp. developed	334.5	393	323
Per cent of rated capacity	83.6	80.6	74
Boiler hp. to fan	....	60	....
Net horsepower	....	386	....
Approximate transfer rate (R)	5.08	6.92	4.65



Three Bacon waste heat boilers are installed at South Chicago

In the installation of Bacon boilers at South Chicago there are three units located in the gas house opposite No. 1 open-hearth. The three boilers are connected to furnaces 1, 2 and 3 by separate underground gas flues. There are no inter-connecting flues, therefore each furnace with its boiler constitutes a unit. The grouping of the three boilers in a single building was due primarily to space limitations, but it is very advantageous from an operating standpoint. While this entails considerably longer gas flues than customary, the heat in the gases is conserved by flue linings of insulating brick. Each flue has an area of about 30 sq. ft., giving an average gas velocity of 1500 ft. per min.

The boiler unit consists of a Foster superheater, a two-pass vertical fire-tube boiler, and exhaust gas fan driven by an electric motor. The superheater is set with elements in vertical position in the horizontal gas flue, close to the first pass of the boiler. The boilers consist of two vertical shells or passes, with steam and water spaces cross-connected with circulating pipes. The waste gases enter the bottom of the first pass, flow upward and through a transfer flue to the top of the second pass, whence they flow downward and into the fan which is adjacent to the bottom of this pass.

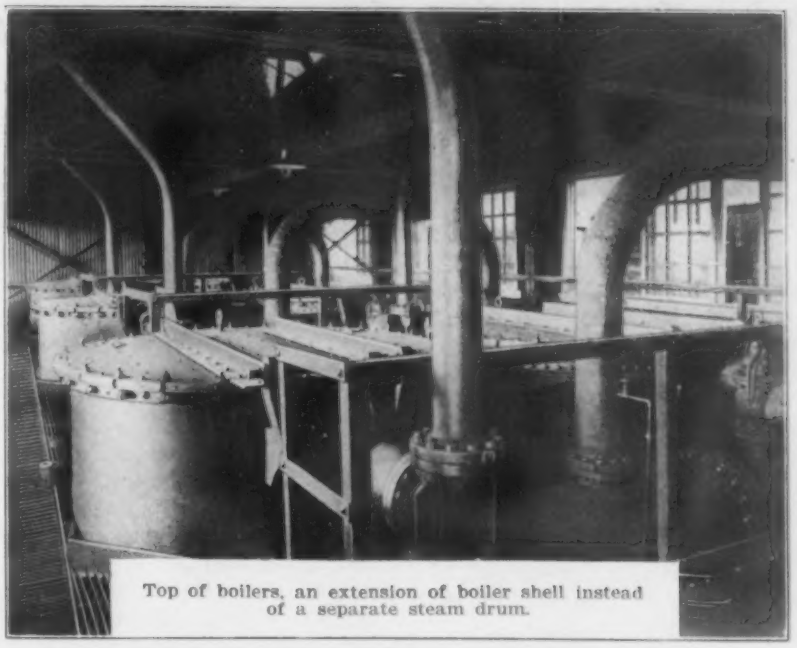
Each pass consists of an 80-in. diameter shell containing 253 3-in. diameter tubes rolled into tube sheets 15 ft. apart. The total internal heating surface of the tubes is 5670 sq. ft. for both passes. The water level is carried 3 ft. 6 in. below the tube sheets, consequently 77 per cent of the heating surface is effective for evaporation. The actual results show 50 to 60 deg. superheat from the effect of tubes extending through the steam space.

The waste gas fan, which has shown a normal operating efficiency of 73 per cent, was furnished by the Green Fuel Economizer Company and is the "radial flow" type. The fan requires 40 brake hp. and is driven by a 50-hp. Westinghouse induction motor, direct connected through a flexible coupling. The exhaust gases from each fan are discharged upward directly into the atmosphere through unlined steel stacks 3 ft. 6 in. diameter x 60 ft. high.

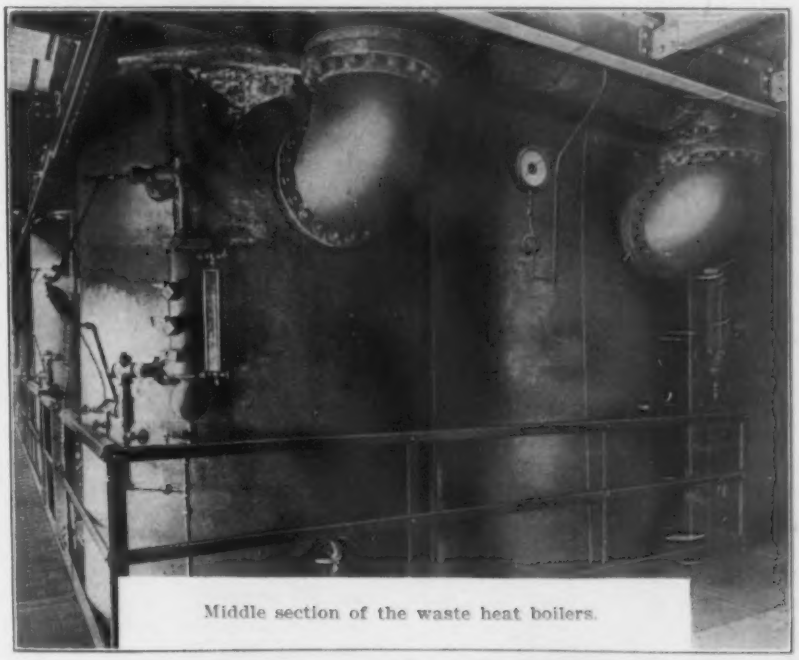
The feed water is taken from the cooling plates and gas valves of three adjacent open-hearth furnaces, and is collected in an underground header which conducts it to the Cochrane feed water heater serving as a reservoir and filter, as well as giving some heating effect from the exhaust of the feed pump. The heater is provided with an auxiliary water connection from the central pumping mains. There are two 10 in. x 6 in. x 10 in. horizontal duplex feed pumps, of which one serves as a spare.

As one basis of comparing the performance of this fire-tube type boiler with waste heat boilers of water-tube design the data in the accompanying table derived from tests made over periods of approximately 36 hr. under normal operating conditions are available.

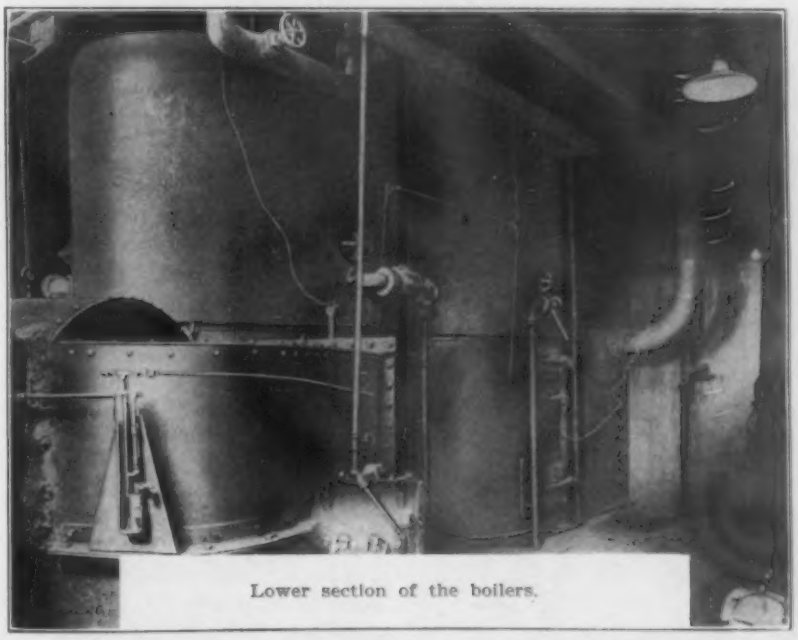
It will be noted that the excess of heating surface over 4400 is area effective for superheat. The low figure for the rate of heat transfer is due to the fact that these boilers are somewhat too large for the amount of waste gas available. This is also indicated in the figures for draft loss and the weight of gas per hour per square foot of heating surface.



Top of boilers, an extension of boiler shell instead of a separate steam drum.



Middle section of the waste heat boilers.



Lower section of the boilers.

The output of iron ore in the Caen district of Normandy is reported as 1,000,000 tons per year at present. When the war broke out there were 21 mining concessions of which 12 were being worked, producing annually 750,000 tons of ore. New plant equipment has since been installed. Both the mines and the blast furnaces are being operated by the French Government. In 1900 the output had fallen to 142,000 tons of iron ore as compared with 12,000,000 tons produced by Lorraine, though the Normandy ore is said to be richer. In 1909 Thyssen, the German ironmaster, obtained a foothold and later considerable German and Dutch capital was invested there.

The number of factories under government control in Great Britain is now 4512.

After-the-War Effects of Two Conflicts

Some Exhibits Bearing on Economic Conditions at Home and Abroad in the Eighteen-Sixties and Seventies

BY B. E. V. LUTY

As a contribution to the demand for information and suggestion as to what may happen after the war, a collection of some statistics of trade currents during and after the Civil War and the Franco-Prussian War may be of interest. In the accompanying diagram the statistics of nine trade currents are plotted, as follows:

Clearings of the New York Clearing House.
Failures in the United States—amount involved.
Increase in railroad mileage in the United States.
Production of pig iron in the United States.
Value per ton of pig iron, No. 1 anthracite, delivered Philadelphia.
Imports and exports of the United States.
Imports and exports of France.
Imports and exports of the United Kingdom.
Percentage of labor employment in the United Kingdom.

Pitfalls to Be Avoided

There are many pitfalls to be avoided in studies of this sort. Perhaps the most dangerous one is of a class that ought to be recognized readily because it is so common, that of erroneously assuming *post hoc, ergo propter hoc.* Industry expands, and if an important event has occurred just before the expansion, the expansion is attributed to it. One should always ask, "Might this not have occurred in any event?"

The fact is that since the Dark Ages man has progressed more and more rapidly. Selecting almost any date in the past few centuries, it would have been possible to summarize the world's progress up to that time and reach the conclusion that more progress along certain lines had been made in the past generation or two than in all the time that preceded. A concrete illustration of this principle lies before the writer at this moment, in a book published in August, 1889. The opening sentence in the preface reads:

> The economic changes that have occurred during the last quarter of a century—or during the present generation of living men—have unquestionably been more important and varied than during any former corresponding period of the world's history.

If such a book had been written a half century earlier it might have been necessary to take a half century, instead of a quarter century, to find the noteworthy amount of change and progress. If a book had been written at the beginning of the eighteenth century it might have been necessary to take in the whole of the seventeenth century. If a book had been written Jan. 1, 1909, it would have been possible, as to the United States at least, to have taken only the decade immediately preceding to find such grand progress in industry as to be worthy of a book. As a matter of fact, a whole library of such books has been written in the past few centuries. The fact illustrates one of the pitfalls mentioned. The supposititious book last mentioned would have covered the decade immediately following the Spanish War. The fact is that the world grows more and more rapidly. That is natural and is not due to any one cause.

Another pitfall is the tendency insensibly to assume that a principle that is true of an individual will prove true of a community or a nation, apparently similarly circumstanced. A great calamity befalls a man—his house, representing all his savings for years, burns down with no insurance, and he suffers privations for years in re-establishing himself. In apparently the same circumstances, a nation will not necessarily fare the same way. Nations must be considered in the light of national, not individual, experience.

Another pitfall to be avoided is that of unconsciously fixing a time when a development, a period of prosperity or a period of adversity, is to occur. The reasoning that such a thing is to occur may be perfectly correct, while the fixing of the time for it may have involved the use of very loose or incorrect methods, and when the development does not occur the whole idea is abandoned; whereas the development may eventually occur, the time alone having been incorrectly gaged.

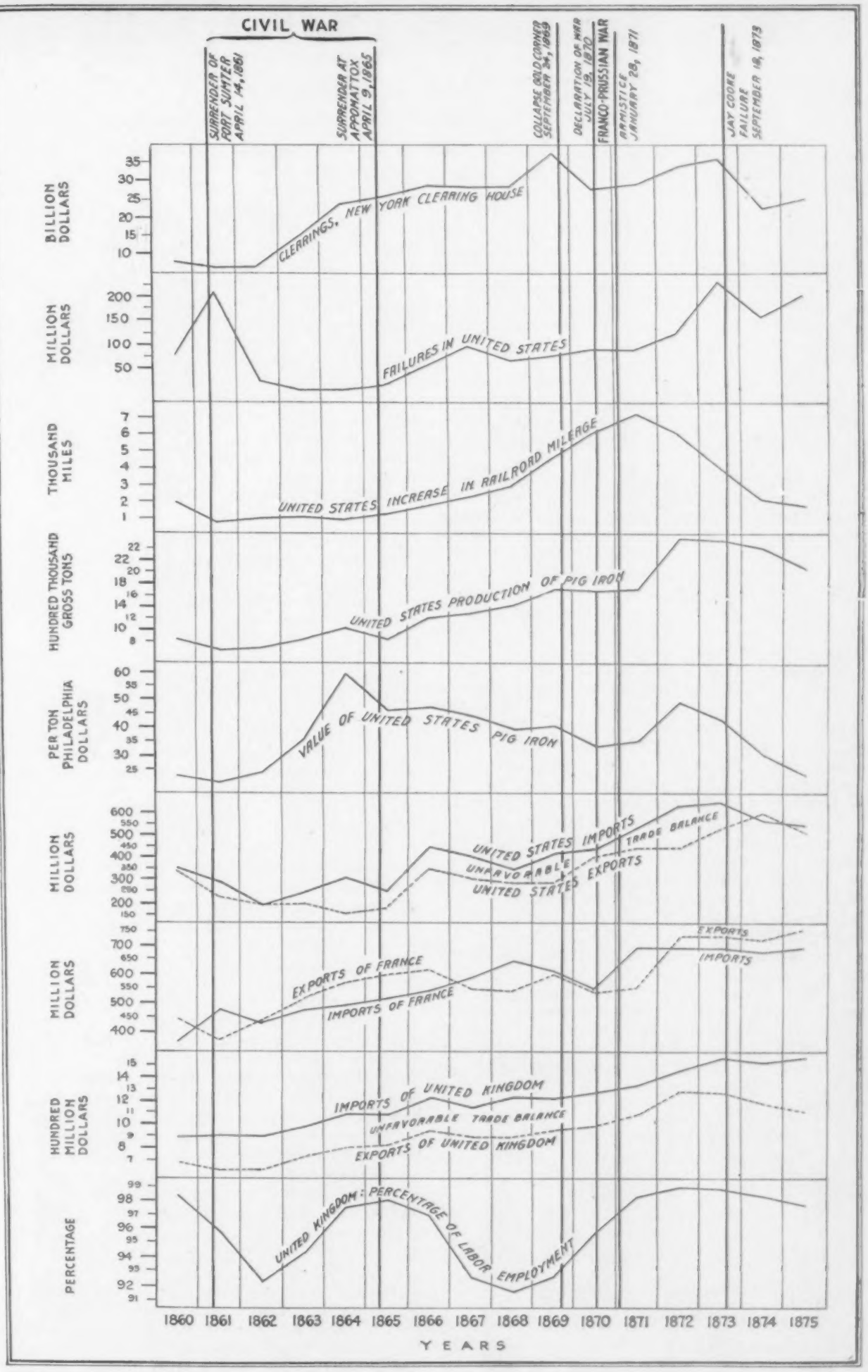
The Civil War

A crisis occurred in the United States in August, 1857, serious, but considerably less severe than that of 1837. The ensuing industrial depression reached its worst stage in 1859. There was a distinct improvement in 1860 and undoubtedly business would have been good during the next few years if there had been no Civil War. The dates for the beginning and end of the Civil War are plotted from the business rather than from the military or the civil viewpoint. It was the surrender of Fort Sumter, April 14, 1861, not the attack upon it two days earlier, or the secession of South Carolina on the night of the preceding Presidential election, that proved there would be war; for it was on the next day, April 15, that President Lincoln called for 75,000 volunteers. Likewise the fate of the war was fully known by the fall of Richmond in 1864, but the resumption of the arts of peace only followed the surrender at Appomattox Court House, April 9, 1865, when the Southern soldiers were told to take their horses home with them for the spring plowing.

The inception of the Civil War caused a great increase in business failures, a great decrease in railroad building, a considerable decline in business activity as represented by clearings of the New York Clearing House and an apparently small though really serious decline in pig iron production. The price of pig iron decreased.

As the war progressed large volumes of paper currency were issued and gold went to higher and higher premiums. Prices advanced, but it would be unsafe to undertake to determine, by reducing prices to a gold basis, how much of the advance was due to currency inflation. Business failures in 1863 and 1864 were extremely small, this being due, perhaps, to that inflation.

Following the Civil War there was great expansion in business. All authorities agree that the return of the million Northern soldiers to industry failed to cause any disturbance; the men were very readily absorbed. The whole history of industry


CIVIL WAR
SURRENDER OF FORT SUMTER APRIL 14, 1861
SURRENDER AT APPOMATTOX APRIL 9, 1865
COLLAPSE GOLD CORNER SEPTEMBER 24, 1869
DECLARATION OF WAR JULY 19, 1870
FRANCO-PRUSSIAN WAR
ARMISTICE JANUARY 28, 1871
JAY COOKE FAILURE SEPTEMBER 18, 1873
BILLION DOLLARS
CLEARINGS, NEW YORK CLEARING HOUSE
MILLION DOLLARS
FAILURES IN UNITED STATES
THOUSAND MILES
UNITED STATES INCREASE IN RAILROAD MILEAGE
HUNDRED THOUSAND GROSS TONS
UNITED STATES PRODUCTION OF PIG IRON
PER TON PHILADELPHIA DOLLARS
VALUE OF UNITED STATES PIG IRON
MILLION DOLLARS
UNITED STATES IMPORTS
TRADE BALANCE UNFAVORABLE
UNITED STATES EXPORTS
MILLION DOLLARS
EXPORTS OF FRANCE
IMPORTS OF FRANCE
EXPORTS
IMPORTS
HUNDRED MILLION DOLLARS
IMPORTS OF UNITED KINGDOM
UNFAVORABLE TRADE BALANCE
EXPORTS OF UNITED KINGDOM
PERCENTAGE
UNITED KINGDOM: PERCENTAGE OF LABOR EMPLOYMENT
1860 1861 1862 1863 1864 1865 1866 1867 1868 1869 1870 1871 1872 1873 1874 1875
YEARS

Trade Currents During and After Two Wars

in the United States for about eight years following the war was one of almost constant expansion and improvement. Yet there were some great uncertainties. There was the famous "Black Friday," Sept. 24, 1869, caused by the failure of the gold corner attempted by Smith, Gould, Martin & Co., the weak link in which was probably the dependence placed upon efforts to keep President Johnson from selling gold out of the Government treasury. The production of pig iron suffered only a slight relapse in the next two years, while the production in 1872 was 49 per cent greater than in any preceding year, the price being high at the same time.

Using New York bank clearings as a gage, and taking the average annual clearings in the seven years ended 1860 as 100, the annual average in the five years 1861-65 was 243, while for the seven years following, through 1872, it was 478.

Railroad building increased very rapidly, reaching the maximum in 1871, when the year's increase was 7379 miles, against an average of about 2000 miles a year for a number of years preceding the war.

It is the common view of the present generation that, for the United States at least, prosperity and a large "favorable" merchandise balance in foreign trade go hand in hand, and that view is well supported by recent statistical facts. The year 1898 showed a sudden and large jump in the favorable balance, while the industrial depression of the nineties ended and a period of great prosperity began. The present feverish activity occurs with a vastly larger favorable trade balance.

It is therefore of particular importance to note that prior to 1876 the trade balance was almost invariably unfavorable; and as business activity increased after the war the unfavorable balance increased greatly. The unfavorable balance had ranged from $20,000,000 to $60,000,000 per year before the war, while in 1872, by far the best of all the good years in the iron industry after the war, it mounted to no less than $182,000,000. In 1874, the year following the panic, the balance switched, and became "favorable" to the extent of $19,000,000. A study of trade balances over a long period would show that in general neither an excess of exports nor an excess of imports must be called "favorable." What has been favorable in one period of development has been unfavorable in another. The better analysis of the foreign trade during and after the war is made by adding imports and exports together. Taking foreign trade just before the war at 100, during the five years 1861-65 it stood at 66 and during the eight years thereafter it averaged 127. There was scarcely any decline in the total of imports and exports in the ensuing industrial depression.

Pig-Iron Production and Prices, 1860-1879

	Production, Gross Tons	Average Price
1860	*821,223	$22.75
1861	653,164	20.25
1862	703,270	23.87
1863	*846,075	35.25
1864	*1,014,282	59.25
1865	831,770	46.12
1866	*1,205,663	46.87
1867	*1,305,023	44.12
1868	*1,431,250	39.25
1869	*1,711,287	40.62
1870	1,665,179	33.25
1871	1,706,793	35.12
1872	*2,548,713	48.87
1873	*2,560,963	42.75
1874	2,401,262	30.25
1875	2,023,733	25.50
1876	1,868,961	22.25
1877	2,066,594	18.87
1878	2,301,215	17.62
1879	*2,741,853	21.50

*New high record.

Illustrative of the course of the iron industry, the foregoing statistics of pig iron are presented. The price given is that of No. 1 anthracite at Philadelphia.

Business in Foreign Countries

Detailed comparisons of the trade of foreign countries during and after our Civil War would show various slight changes, but they might have been due to many causes other than the war. In general, there was no great change to be observed. Their trade did not fall off during the war, while afterward it was approximately as much greater than before the war as was the case with the United States. During the war England suffered severely from lack of American cotton, but that was only one item. How much of our prosperity was due to the war and how much was merely participation in a world expansion of trade is therefore debatable ground. The one fact that must be accepted is that there was great expansion. A part of it, and perhaps no inconsiderable part, was due to the operations of "carpet baggers" who loaded Southern States with great debts for improvements by which the North endeavored to prosper.

The Franco-Prussian War

The Franco-Prussian war was very short, compared with the Civil War or the present war, the dates being: First mobilization, July 15, 1870; first declaration of war, July 19, 1870; declaration of an armistice, January 28, 1871. The armistice was accepted generally as a certain step toward peace. Nothing of importance occurred, therefore, that could be assigned strictly to the fact of the war being in progress. Everything may be assumed as due to the shock of the war having begun. The only study can be, therefore, of what occurred after the war. Unfortunately there are no German statistics, as the German empire was only then formed.

Omitting 1870 as a year partly of war and comparing in all cases five years before 1870 with five years after 1870, French imports increased 19 per cent, while exports increased 20 per cent. There was no disturbance in this respect, no feverish rush to get money in foreign trade to pay the indemnity. British imports increased 27 per cent, while exports increased 32 per cent. The expansion was due in considerable part to the opening of the Suez Canal in 1869.

The one great fact about trade after the Franco-Prussian war was that it induced the greatest economy and industry in France, whereby all commentators agree that France prospered much more in the decade or two after the war than would have been the case if there had been no war, or if it had ended differently, while it is quite certain that Germany was led to extravagance and on the whole was injured. It even got into the comic papers, one German comic paper saying: "Let us have another war; let us be beaten and pay an indemnity and then we shall be prosperous again!" Note the "again."

Conclusions

What the historic facts show is that nations can be prosperous after a war, whether their own or that of other nations. It is not proved that prosperity must come. Prosperity is due to economy and industry. The people must produce and must not waste. War has a crippling effect and it also has a stimulating effect. Whether a war, of itself, produces prosperity depends on whether the stimulus exceeds the crippling.

The Iron-Ore Reserves of the World

Sufficient for 800 Years if Rate of Pig-Iron Production Is Constant —But That Increases Markedly

BY H. H. CAMPBELL

H. H. CAMPBELL

THE International Geological Congress which met at Stockholm in 1910 attempted to estimate the amount of iron ore in the world. The Official Report gives first an inventory of "available" ore, meaning that which conforms to present standards of iron content and which would be considered workable to-day by practical men. Next an estimate was made of the reserves of "potential" ore, meaning those deposits which will be drawn upon in the future after the richer and more desirable ore is exhausted.

It is rather confusing, in dealing with these figures, to speak of the weight of mineral in the ground. Thus there are large beds of ore in Minnesota, Brazil, Chile, Sweden, Lancashire, Elba and elsewhere which carry as much as 65 per cent of iron. On the other hand, a considerable portion of the pig iron made in the world comes from ores which in the natural state contain less than 35 per cent of iron, as for instance the Minette ore of German and French Lorraine, while some, as in Lincolnshire and the Cleveland district in England, carry less than 30 per cent of iron. For this reason, it was considered wise in issuing the Stockholm report to calculate how much iron this ore would make; and so the accompanying table shows, not the amount of mineral in the ground, but the tonnage of equivalent pig iron.

Iron Ore Resources of the World in Terms of Pig Iron
(1 unit equals 1,000,000 tons of pig iron)

	From Available Ore	From Potential Ore
Europe	4,733	12,085 plus considerable
America	5,154	40,731 plus enormous
Australia	74	37 plus considerable
Asia	156	283 plus enormous
Africa	75	? plus enormous
Total	10,192	53,136 plus enormous

Bessemer and Non-Bessemer Ore

The reader will naturally ask about the relative amounts of low-phosphorus and high-phosphorus ores. Unfortunately no figures can be given which are worth very much; but it will be shown in succeeding articles that we will not be very far wrong if we assume that the reserves of acid Bessemer ore in the world will make about 1,500,000,000 tons of pig iron; and that the ore suitable for making metal for the basic converter will produce something like 2,200,000,000 tons. By subtracting from the total given in the table we find that the available ores that will not make metal suitable for either the acid or the basic converter represent 6,500,000,000 tons of pig iron. Information is lacking about the phosphorus content of a great proportion of the potential ore. A part, possibly a large part, may give an iron fit for the acid converter; but a much smaller portion will produce basic Bessemer pig iron; for even if the phosphorus be high enough, it is difficult or impracticable to make iron from lean silicious ore and have it low both in silicon and sulphur. So, although we do not know very much about these potential reserves, it is probable that they will ultimately make iron for the basic open-hearth furnace.

Available and Potential Ore

Notwithstanding the appearance of positiveness in the table, no real line can be drawn between available and potential ore, for there are many points to be considered, one of them being the feasibility of mining the mineral. The ore may occur as thin veins or pockets in hard rock, as in Sweden and the Ural Mountains; or it may be found in irregular and deep-lying beds of loose material, mixed with layers of worthless rock or earth, as in some places around Lake Superior and in Russia in the Kertsch Peninsula. Often we are far from certain as to the extent of the deposit taken as a whole; and still more uncertain as to how much of the ore is rich and how much poor. This is the case in the large and important fields in the Cleveland district of England and in Lorraine.

Sometimes the deposit extends under a great body of water, as in a few places in Minnesota; or even under the ocean as at Barrow-in-Furness. At this last place, long years ago, a dike was built to push back the ocean; and some day the same method may be followed in Newfoundland. Here on Bell Island are 113,000,000 tons of ore, while in the adjacent submarine area there are 3,522,000,000 tons, assuming that the beds maintain their thickness and their stratified character beneath the ocean. We find, however, that this calculation includes all beds of ore which are over 1 ft. in thickness; and we are to suppose that it will be profitable to run a tunnel under the sea for a distance of six miles, and pump out the seepage of the Atlantic Ocean, in order to recover the mineral in a seam 1 ft. thick, where the ore is not very good after we get it.

Lake Superior

In many cases the content of iron is the most important factor in determining whether or not an ore is available, but even here we can have no fixed standards. Thus in the account of the Lake Superior district, this Swedish Report states that no ore was considered to be "available" unless it carried 50 per cent of iron; yet the regular catalogue of Lake ores for 1916 gives 85 mines where the iron is less than 50 per cent in the natural ore; and 23 where it is below 50 per cent in the dried sample. About one-third of these ores atone for their low iron content by carrying a certain proportion of manganese; but the rest have no excuse to offer. Twenty-five years ago these ores could not have been marketed, but it is realized to-day that we cannot always have ore with 60 per cent of iron. We are already accepting 50 per cent without a murmur, and some day even that standard must be lowered. We are told that the available reserves at Lake Superior amount to 3,500,000,000 tons, while the potential reserves are twenty times as much. It is said that there is an "inexhaustible supply" of

40 per cent ore; but this term has been used ignorantly and carelessly so many times that it has lost its meaning.

Transportation

Thus far nothing has been said about the location of the ore fields; but very often the cost of transportation is the one great consideration that decides the question of the marketability of the ore. Thus Great Britain in 1913 turned out 16,000,000 tons of ore, and nine-tenths of it averaged below 30 per cent in iron. It pays to mine this lean mineral, because the coal fields of England are close by; but if these same deposits were situated in remote portions of the earth, far from any fuel supply, we could not afford to bring the ore to North Atlantic ports.

In exceptional cases it does not pay to transport even the richest ore. Chile and Brazil have contributed very little to our blast furnaces, although they boast immense deposits of pure mineral. Australia has sent practically nothing to our markets; but this was not because there was nothing to send, for a steel works was put in operation at Sidney a little over a year ago, which stands over a coal mine and is supplied with ore running 65 per cent in iron and 3 per cent in silica, while the pig iron contains only 0.12 per cent of phosphorus.

How Long Will the Ore Last?

We have seen that there is great uncertainty about the actual quantity of ore in the ground, as well as the amount that it is practicable to mine; also that no line can be drawn in regard to iron content, and that the cost of transportation is a vital factor. In view of these conditions, it could not be expected that all the geologists who formulated this Swedish Report, would agree on details of classification; but their work is the only complete investigation ever made into the world's supply of iron ore. Therefore it will not be wholly a waste of time to assume for the moment that the results are correct, and we will see what the outlook is for the future.

The table shows that there is enough good marketable ore in sight to-day to make 10,200,000,000 tons of pig iron. In 1913, which was the last normal year, the output of pig iron was 78,500,000 tons. On this basis the supply should last about 130 years at the present rate of output. The potential ore represents 53,000,000,000 tons of pig iron; so that this should last another 700 years, not allowing for any increase in production. But we cannot for one moment assume that production will remain stationary. The amount of iron made in the world is increasing constantly; and during the last century the rate of growth has been wonderfully constant.

Output of Pig Iron

In A.D. 1500 the total production of pig iron in the world is said to have been only 60,000 tons, although we can hardly suppose that any accurate records were kept. Two centuries later, in the year 1700, the output is given as 104,000 tons; in 1800 it was 375,000 tons, while in 1900 the world made 39,557,000 tons of pig iron. Thus during the sixteenth and seventeenth centuries the rate of increase was very low; during the eighteenth century production increased less than four fold; during the nineteenth century it increased more than a hundred fold. This great change was due to the invention of the steam engine, the rolling mill and the puddling furnace, all of which were developed so late in the eighteenth century that they did not have time to revolutionize the iron industry; and as a consequence they did not have their full effect until about the time of the Napoleonic wars. So in order to see what the rate of increase has been under modern conditions, let us examine in detail the records from 1810 to 1910.

Year	Tons	Per Cent Increase in Decade	Year	Tons	Per Cent Increase in Decade
1810....	616,000	..	1870...	11,616,000	62
1820....	1,010,000	64	1880...	18,109,000	56
1830....	1,585,000	57	1890...	27,252,000	54
1840....	2,680,000	69	1900...	40,186,000	47
1850....	4,422,000	65	1910...	65,466,000	63
1860....	7,180,000	62	1913...	78,519,000	See text

It must not be supposed that these figures are accurate; for sometimes there are two conflicting sets of statistics from an important country, both seemingly authentic; while information is often wholly wanting concerning such countries as China and Mexico. Sometimes we are left in doubt as to whether Bosnia is included in Austria, or Finland in Russia; and always we must ask if the particular year marking the end of a decade is entirely representative and normal.

But these errors are lost in the sweeping march of the figures in the table. Taking the 100 years from 1810 to 1910, the average increase in output of pig iron for a decade was 60 per cent; and the progress was as uniform as could be expected. From 1880 to 1900 the rate was lower, but there was a return to the average in the next decade. In the three years from 1910 to 1913, the increase was 20 per cent, and by compounding we get a rate equivalent to 84 per cent for a ten-yr. period.

During the 50 years from 1810 to 1860 the world's output of pig iron increased nearly twelve fold; during the same period from 1860 to 1910 it increased nine fold; so that the rate of increase has been less since the invention of the Bessemer process than it was before. If production increases in the future as it has in the last half century, then in 1960 the world will make 600,000,000 tons of pig iron, and all the available ore now known will be exhausted. By 1990 the output of pig iron will be nearly 2,500,000,000 tons; and all the potential ore given in our table of ore reserves will have gone through the blast furnace.

Asia and Africa

We have assumed for the sake of argument that the table given at the beginning of this article is correct; but a glance will show that some of the records are open to question. The one predominant fact is that hardly any iron ore, either available or potential, is credited to Asia or to Africa. The figures show that Europe and America taken together contribute 97 per cent of the available ore and more than 99 per cent of the potential reserves. Now this cannot be the real situation. Asia and Africa are geologically quite similar to Europe and America; and they contain all the other common minerals. Nature did not forget them when she distributed gold, copper, zinc and lead, and there is no reason to suppose that iron was forgotten.

Moreover, we know that for years Algeria and Tunis have been supplying iron ore to England and Germany, and that there are many deposits of both coal and ore in Siberia and in China. So we feel certain that if these continents were explored with anything like the thoroughness with which men have surveyed western Europe, great fields of iron ore would be found. It is not necessary to assume that there are vast beds of rich ore in these continents, but merely to suppose that there are deposits of lean mineral, just like those which are

scattered all over Europe and the United States and which contribute the raw material for a large portion of the iron and steel produced to-day.

Summary

The Report of the Swedish Congress issued in 1910 showed that all the iron ores of the world, both rich and poor, that is really known and mapped out, would make enough pig iron to last over 800 years at the present rate of production; but the iron output of the world has increased a hundred fold in the last century, and the rate of increase in recent years is practically the same as it was 50 years ago. If this progression continues, then all this ore, good and bad, will be gone before the end of the present century. It is certain, however, that no proper survey has ever been made of Asia and Africa; and undoubtedly enormous quantities of lean ore exist on both these continents; in fact the Swedish Report stated that such reserves did exist, although accurate information was wanting. But beyond the iron ore tabulated in this Report, there is a vast quantity of lean mineral which cannot be utilized to-day, but which some time, and perhaps before the end of this century, will make the iron and steel of the world.

Increasing Use of Secondary Machine Tools

A War-Time Development Which 1916 Has Accentuated—New Entrants Upon the Field of Special Purpose Tools

BY C. A. TUPPER

WHILE continued progress has been made in the past year in applying special purpose tools to a great and increasing volume of work, another tendency brought about in the war period by practically the same conditions is of equal or greater importance. This is the more extensive use of what may be termed secondary machine tools, as distinguished from lathes, boring machines, slab milling machines, planing machines, drill presses, etc., and to the improvements in their design which have permanently raised them to a higher plane of service than heretofore.

Further, these secondary and auxiliary machines, without essential alteration in character, in numerous instances have entered the field of special purpose tools and will maintain their place there even when normal industrial conditions are restored. This has also been accompanied by the manifold application of manufacturing automatics or semi-automatics to lines of work for which they were formerly unthought of or but little used; while such tools, in turn, are being closely crowded by other standard equipment applied to special purposes as mentioned farther on.

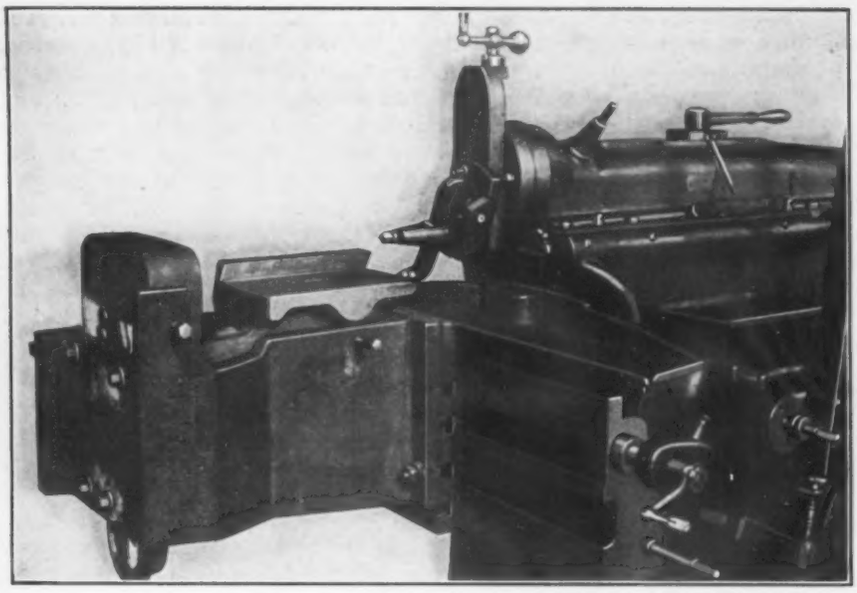
New Place of the Shaping Machine

Among the tools with reciprocating motion which have come to the fore is the shaping machine. Besides the various classes of auxiliary service for which it is used in machine shops, it has been taken up as a "manufacturing" proposition, where there is work to be done in large quantities. Some large and notable installations of this kind have been made, as in the manufacture of heavy hardware and builders' hardware. The introduction of the vertical type, with swiveling ram head, tilting ram, table index, etc., has also opened up for the operation of the shaping machine a field never before considered possible, such as difficult work in machining convex and concave surfaces, as well as squares, hexagons, octagons and complicated die clearances. Within its range this machine also takes the place of the cumbersome but heretofore necessary old-style slotting machine, while light, rapid slotters of a very modern type are advancing quite as rapidly in other directions. For standing up under constant and relatively heavy work, prolonged over what would formerly have been considered unusual periods, greater strength and more bearing surface have been secured by such devices as large diameter gear hubs and by casting the bearing of the bull wheel integral with the frame. This elimination of parts that have to be bolted on and kept in alignment, with reduction of overhang, and facility for adjusting length and position of stroke while the machine is in operation, is typical of the best modern practice in bringing secondary machines up to the standards heretofore maintained for primary cutters.

In heavy machine shop service the portable draw shaping machine is making new records, particularly when provided with various attachments. These tools enable operatives to get at places on heavy or complicated castings, for the frames of engines and other large pieces of industrial machinery, which it would take a special rig to machine or would involve multiple settings before standard tools. Such shaping machines originally came into service some years ago for work like facing the inner edges of the heavy round column frames of large vertical pumping engines, finishing the concaves of large bearings representing odd segments of circles; cutting out pockets extending under the beds of long, bulky machines; making slots in cylindrical surfaces which would be out of reach of any usual tool; finishing off a single casting of too great length or too eccentric lines to be worked upon by a planing machine, and machining bosses or projections on either the exterior or interior of a huge casting which would otherwise be inaccessible to hand tools. The recent necessity for keeping regular shop equipment steadily at work, and eliminating as far as possible all idle time for settings, has given a great impulse to the use of portable draw shaping machines; hence their service is constantly being extended as new applications are found for them.

Slotting Machines

Heavy slotting machines maintain their usual place in the shop and have gradually been improved by the addition of such features as swivel bar guides which enable cutting to be very accurately done, either side or vertical, also sliding gears for speed changes. Light, rapid slotting machines, however, probably show the greatest advance in practice. With these, as in the manufacture of typewriter top bar plates or other parts which require the indexing and cutting of radial slots, practically automatic operation can be secured, thus putting them



A single-purpose tool has been made of this shaper by removing the regular table and bolting a special jig to the crosshead slide

in a class with manufacturing automatics. Milling machines, when used for the same work, require special attachments. Screw slotting, with special saws, is typical of another class of service which for that particular purpose is done on screw machines, but can best be performed for general lines by light slotters.

Keyseating Machines

Similarly, the keyseater, whose function was formerly confined very strictly to the operation indicated by its name, has also become a manufacturing tool and is being advantageously used for a great variety of small slotting operations, some of which are complicated to a considerable extent by the positions in which the cuts have to be taken. These are exemplified in such diverse lines as the production of automobile and motor truck parts and accessories, locomotive parts, electrical machinery, small arms and light ordnance, pressed and drawn steel specialties, gasoline engines, pumps, agricultural implements, sewing machines, woodworking machinery, power saws, combined chucks and parts of machine tools themselves. Such operations are particularly serviceable in such work as slotting the interior surface of pieces cast in halves or quarters and for either straight or taper holes. The keyseater is now, in fact, being made a very handy tool in numerous shops throughout the country, and almost any shop superintendent, with the exercise of a little native ingenuity, can figure out uses for this or a small slotting machine in connection with the work of the average plant. Keyseating milling machines are also made as removable attachments for other tools. Manufacturers of such machines, within the limitations of their scope, can suggest layouts and rigs which will enable various slotting operations, both single and straddle, to be performed with good economy.

Screw Machines

The screw machine has long been recognized as a tool of great general utility, for the reason that almost any small part with a cylindrical body can be produced on it; but the competition between hand-operated and automatic screw machines is still a lively one, with experience favoring the latter for rapid production. The principal question for users, for many months past, has been to obtain machines of either type, while the ingenuity of shopmen and builders has been devoted to inventing or improving appliances for doing special work more rapidly and economically. The work accomplished on screw machines with multiple spindles continues to show more and more striking results. Quite a number of simultaneous operations can be performed on a piece, or progressive operations on different pieces. Accuracy is best insured and saving of time effected by the use of the best obtainable screw cutting die heads, self-opening and adjustable.

An analogous tool found of great service in many plants is the automatic threading lathe, which will handle not only ordinary pieces but also very heavy work, as the threading of large worm gears.

Milling Operations

Milling machines and milling attachments have assumed such a range and variety of form that the question "When is a milling machine not a milling machine?" might be pertinently asked on many occasions. There is, however, no question that milling in its different applications, has become one of the greatest aids both in solving shop problems and in bringing about rapid production. This tendency developed long before the war and no feature of American machine tool practice was so eagerly taken up by Europeans; but in the past two years it has continued to make great progress on both sides of the ocean. Many operations for which standard tools were formerly considered necessary are now being much more speedily milled.

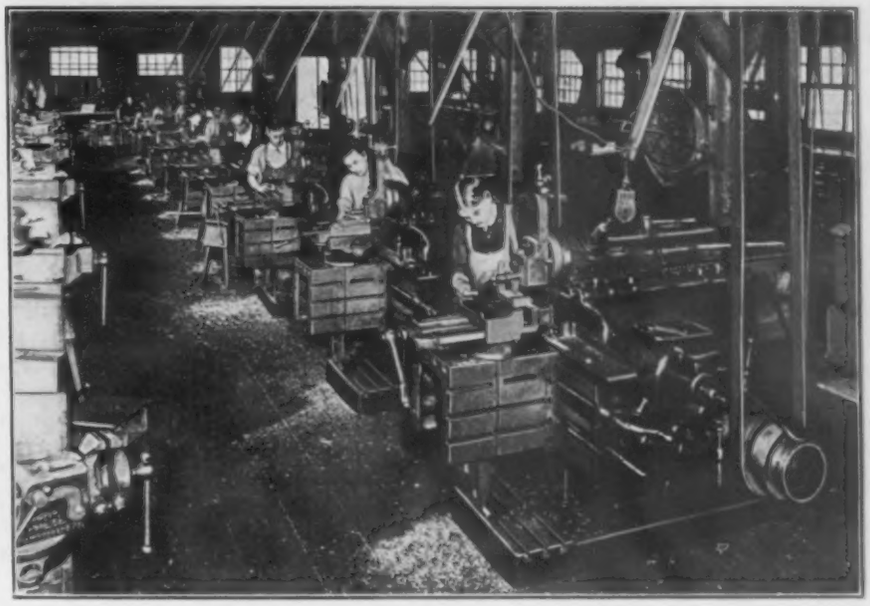
The use of mutiple spindles on milling machines, universal dividing heads, sub-heads and attachments which will enable other operations such as drilling and reaming to be performed are also advances over former practice which have come more largely into vogue during the last year; while in the same line is the tendency to use heavy machines and set rows of castings for machining at one pass. Some such parts are not infrequently finished on the sides and top or bottom simultaneously at one setting.

Certain types of small milling machines, the spindles of which can be rigidly locked at any angle, also come within the range of manufacturing automatics.

Drilling Machines

While drill presses are classed as primary tools and do not come strictly within the scope of this article, it may be remarked in passing that the crowding to which they have been subjected of late has resulted in heavier designs or at least the use of larger sizes than formerly. Munitions work, with the necessity of large production in the quickest possible time, coupled with extreme accuracy, has demonstrated the need of running drills which will not be strained under such conditions, and will use the toughest high speed steel on a manufacturing basis. From its nature, there is no tool which will show the effects of illiberal dimensioning so quickly. The use of circular or radical multi-head drills and gang drills is naturally increasing as the opportunities are found, and with these the factors just mentioned are especially important.

Exigencies of wartime production both in this country and abroad have given a great impetus to the use of portable electric drills, which have the motor housing directly in the head and are absolutely self-contained. The advantages of a tool of this kind, whose connection can be plugged in whenever there is a socket on an electric circuit, are so obvious as to require no extended comment. It can be used for a great variety of drilling operations without moving the work, and similar points can be made for corner drills used in working at close quarters. The same idea is carried out with portable grinders. They can be applied equally well to tool work, as on reamers, and cutters or dies, to grinding centers, or to heavy service on crankshafts, rolls, etc., as well as internal grinding.



Shapers in the shops of the Cleveland Hardware Company, Cleveland, working on heavy hardware parts

Saws

Saws and sawing rigs and attachments, from being the Cinderellas of shop equipment, have begun to occupy a very important place in the plant economy. The various means adopted in munitions work for cutting forging blanks and solid bar sections on a large scale for shrapnel and high explosive shell manufacture, and for other purposes, including the use of both tooth and friction saws, wet and dry machines, single and duplex blades, etc., have already been described in great detail in this paper; hence there is no need of dwelling upon the point here.

Threading and Cutting-Off Machines

Even more notable is the improvement in the status of threading and cutting-off machines, whether for pipe and tubing, or the throats, fuses and bases of shells or threaded mating parts of industrial equipment. In addition to numerous special machines, the principal of which has been described, in connection with automobile and munitions work, the design and construction of the older standard machines have reached the point where they can now appropriately be termed "machine tools" along with the better primary and auxiliary shop equipment. More attention than formerly is being paid to the taps and cutting dies, and in the best designs provision is also made for giving each machine an ample speed range for the work within its capacity.

Threading by milling rather than cutting is being practised to an increasing extent, and many of the special machines embody this principle.

Wherever possible, punchings and stampings are being used to get around time-consuming machine work. Hence more attention has been given to the purchase of presses which can be depended upon in severe service. A natural corollary is also the use of more care in the selection of punch and die steel and to keeping the tools in first-class condition. Trimming press work comes in the same category.

Gear Cutting

In no field of machine shop service has there been greater progress made than in gear hobbing, gear cutting or shaping and gear generating. The demand for gear efficiency has increased until it affects machinery of all kinds, even for the roughest kinds of service; while the economy of using individual high speed motors, with reduction gearing, in place of slow speed belted or direct-connected motors, has led to a corresponding need for an increase in gear and pinion production. From the simpler machines used for hobbing or cutting plain spur and mitre gearings, up to the apparatus for the extreme accuracy of generated helical or herringbone gears, every effort has been made to get out designs which will speed up production without impairing the quality of the work produced. With plain gear hobbing or cutting, what amounts to practically one continuous cut will often finish a large number of duplicate pieces fed one after another. Machines can be made entirely automatic except for putting on the blanks and taking off the gears as cut. An interesting by-product of the need for gears is the fact that cast steel gears, as substitutes for cut gears, are being manufactured in much greater quantities and much more perfectly than in former years.

The Advance in Grinding

The remarkable expansion of the past few years in the application of grinding to machine work, for roughing and finishing flat or cylindrical surfaces, straight or taper, exterior or interior, including small holes, is well known, and further notable progress was made in the last twelve months. This is conspicuously true where high carbon manganese, tungsten or hard, tough alloy steel or rather alloy metal is the material to be worked on. Coupled with the above are disc grinding operations, as in the case of cutters, reamers, saws, etc. The latest marked successes have also resulted from formed wheel grinding, where varying curves and diameters are taken care of with an ease that is astonishing. Such formed wheels can be fed straight in against the work without table traverse. The distinction is also emphasized between wet and dry grinding, as in the case of die makers and tool makers working to a fine degree of accuracy, and in some cases a machine which permits the two methods to be combined is the best adapted to the service.

In this connection, also, shop operators have had forced on them the fact that no grinder is more efficient than its wheel, and attention has been more concentrated in the year than ever before upon the comparative merits of different abrasives.

Grinding is fast becoming highly specialized

and numerous machines and rigs, including the portable motor grinders, have been evolved to meet both general and special conditions. For large scale production, however, the year has done much to shake these down into certain accepted standards which have given notably good results, and the tendencies are very encouraging for continued progress. In operations constantly repeated, universal back rests and automatic cross-feed insure duplicate work which brings certain grinders within the field of manufacturing automatics.

Tool Room and Repair Department

Special attention has been given lately to the organization and equipment of the tool room and repair department, both of which should be kept entirely apart from the productive operations. Complete sets of tools throughout in duplicate or more are recommended in the best modern practice, so that the cutters and auxiliary parts will always be in good condition and that no work will be held up on account of dulled or broken tools. This provides for one complete set of tools in service and at least one set in the tool room at all times. Maintenance work of every description is also in charge of this department, and by means of it every productive machine in the establishment can be kept in first-class order. Machine shops in this respect have taken a leaf out of the book of textile plants, where the maintenance staff has long been classed among the actual "producers" and sees to it that every spinning frame, loom or other machine is kept tuned up to good working efficiency. Shop owners have also been impressed more and more with the importance of "tooling" and of purchasing for each machine the full complement of equipment recommended by its manufacturer for the service in which it is used. Neglect of this simple provision has cost metal workers, in previous years, literally millions of dollars in unnecessary time taken for operations. What has been said of tools also applies to standard and special gages of all kinds, as well as calipers, dividers, micrometers, rules, levels, etc.

In Other Metal-Working Branches

What is true of auxiliary apparatus in machine shops also applies in considerable measure to equipment for other branches of metal-working, such as forging presses, forging machines and power hammers, bolt, nut and rivet machines, plate, boiler and tank shop equipment, bridge and structural tools. Furnaces for various classes of heating, forging, annealing, tempering, case-hardening, dressing, etc., enter largely into this phase of the subject. A very pertinent point made by one equipment house is that large scale production demands quick heats plus unvarying accuracy of control. In the latter, electric control and readings from reliable pyrometers have come to play an increasing part, while tests with scleroscopes or otherwise furnish a quick check on hardness.

In joining plates, bars or tubes, autogenous welding has made great gains, and for repairs it is now indispensable. Spot welding of many parts is also being done on electric welders to a far greater extent than a year ago.

All along the line progress has been made; indeed, the outstanding feature is that plant managers are giving so much thought to means of every kind for increasing economy of production. This extends to all details, from cutting compounds, lubricants and waste up to the racks, trucks, conveyors and cranes used for handling material. It includes tool steel, chucks, dies, clamps, lathe dogs, wrenches, etc., as well as the shafting, bearings, clutches, gears and other features of power transmission and speed changes. This bears on the points brought out above, because of the way it all reacts upon the use of the machine tools themselves.

Closer Specialization

The tendencies mentioned at the beginning of this article are further shown in designing which stands for a specialization more marked than even a year ago. It was the old idea that a lathe is a lathe, except for a few general distinctions as between engine, capstan or speed lathes. Each type has now been diversified and adapted to varying conditions of secondary service. It is also becoming difficult to draw the line between a standard lathe and a manufacturing automatic, as many of the former are now designed for highly specialized production in large lots or for general work on the same machines when required, such as combination engine and turret, with or without automatic chuck, bar feed, automatic feed to cut-off, or with boring, forming, tapping and screw cutting attachments and what not. With many machines taper and parallel cuts can be taken at the same time in multiple; with others, after the proper setting of the stops for the first piece has been fixed, different turnings between shoulders and varying diameters can be rapidly and accurately reproduced. On some, by means of special attachments, roughing cuts are taken without disturbing the finish adjustment, as in screw cutting.

It will be seen, from numerous instances which will occur to the reader's mind, how standard equipment has tended—and particularly during the past year—to merge into manufacturing automatics. So far as primary tools are concerned, this is too big a subject to be treated here, but its effect upon secondary and other auxiliary tools has been most marked, while improvements in the latter have in turn reacted upon primary machines.

A further impetus was given to both of these closely related tendencies, during the year, by the scarcity of standard tools and the necessary exercise of Yankee ingenuity to "contrive" the best possible substitutes.

The Coming Economic Struggle

Nor should the effect of this be overlooked when considering the problems facing both American and Canadian shops in the period of economic struggle against European "efficiency" which it is now freely predicted will follow the war. Metal workers on this side of the Atlantic and on both sides of the Great Lakes have learned to adapt themselves with signal success to the needs of large scale production, under high pressure, in veritable minimum of unit time. Individually, therefore, they are equipped and organized as never before; and it only needs proper co-operation, whether through legislation or joint initiative, to bring them to a plane of equality, at least, in competition with the best that the Old World can offer. Such is the larger aspect of tendencies which are, in themselves, important enough to warrant most serious consideration from our metal-working trades.

The 34 x 128-in. three-high plate mill which was built some years ago for the Dominion Iron & Steel Company, Ltd., Sydney, Nova Scotia, has been purchased by the Jones & Laughlin Steel Company, Pittsburgh. The sale was handled by the Mitchell-Tappen Company, 50 Broad Street, New York City, and also included the 132-in. plate shear, tables and a slabbing shear, all of which were built for the Canadian company by the United Engineering & Foundry Company. This equipment was never installed but remained in the custody of the Canadian customs officials ever since its arrival at Sydney.

Production and Cost System for the Foundry

Obtaining the Costs of Individual Lots of Castings in the New Jobbing Plant of the Parsons Foundry Company

THE awakening interest in cost accounting in foundries is bringing forth fruit in the form of foundry systems that are of interest to managers of both foundries and other industries. The system that has just been inaugurated in the new plant of the Parsons Foundry Company, Bridgeport, Conn., is especially worthy of analysis and description because it has been designed to meet the needs of a typical 150-ton jobbing foundry. While simple and workable, it is so complete and comprehensive that a description within the present space limitations must necessarily be confined to the barest outline of the methods pursued and the forms in use.

A Casting That Had 77 Cores

The organization chart, Fig. 1, shows the functions rather than the personnel of the organization. To understand the manner in which these various functions are controlled, let us take up in some detail the duties of the operating executives and clerks. In connection with these duties the forms in use to collect and record costs and to direct the manufacturing activities will be briefly sketched.

Office Manager and Accountant.—The office manager and accountant is held responsible for these duties: Commercial accounting and control of foundry accounting; interpreting customer's orders as to credit, selling price, delivery date, etc., in consultation with other officers of the company; correspondence with customers and vendors; control of purchasing and purchasing records; checking, vouchering and distributing invoices from vendors; writing checks, supervising the making up of pay envelopes and paying employees; hiring and discharging office clerks and maintenance of discipline in office.

It is not possible to go into the details here of the commercial accounting which comes under his charge. It is, however, interesting to note that costs are controlled by the general ledger so that a monthly profit and loss statement may be obtained and the accuracy of the costs proved. While he is in general charge of all accounting, he is required to work in close touch with the foundry recorder in all matters relating to the foundry system and with both the foundry recorder and the foundry superintendent in such matters as estimates on new work, etc.

Foundry Recorder.—This official is in general charge of all clerks making records pertaining to the cost system. Among the duties he directly performs are these: Compiles cost statements of melted metal, castings, patterns and flasks, and plant orders; compiles foundry burden analysis; compiles cost of sales; compiles foundry cost journal; estimates on new work in connection with foundry superintendent; is responsible for physical inventories.

The foundry recorder must watch the reports from the foundry, particularly in regard to materials used in which it is easy for the foundry to be in error and must make frequent checks so that such errors can be absorbed currently in the costs. This is done by means of an inventory adjustment form, Fig. 2. One of his most important duties is making out estimates for new work, in which connection he works closely with the superintendent. The experience of both men and the records of former jobs are drawn upon in making cost estimates, which are compiled upon the same form as is used for cost statements of castings, Figs. 3 and 4.

Payroll and Material Stores Clerk.—One man has charge of all the payroll work and the safeguarding and disbursing of all stores. The payroll is compiled daily. The names of employees, grouped into different classifications, are written on a form which has columns for daily postings of wages earned and weekly totals of hours, earnings, bonus, total earnings, charges and net amount paid. A shorter form without a column for names is used for succeeding weeks so that a new sheet bearing the names does not have to be rewritten until so many changes in the list have occurred as to make it advisable. When an employee leaves the company the date of his leaving is written across his name in red ink.

The total hours worked each day are obtained from time-clock cards. Each morning the payroll clerk obtains from the time distribution clerk the job time cards, Figs. 5 and 6, and checks the time distributed on these cards against the clock card record.

After entering the rate and total amount for each job time card, he checks the total of these against the total day's wage of the employee. In the same manner he checks the total day's payroll against the total of all the time cards. If they agree, he then analyzes the day's payroll according to the following groupings: productive labor on castings, productive labor on patterns and flasks, productive labor on plant orders, foundry standing orders (these are described later). The productive labor tickets are sent to the cost clerk and the expense labor tickets are filed in a drawer indexed to foundry standing order numbers. Discounts for defective castings are made in a manner to be described later.

This clerk also has charge of the stores. He keeps records which tell the quantity on order or on hand and the cost of any material or supply at any time. He works in conjunction with the purchasing agent to see that proper and adequate quantities of materials are on hand as needed. He disburses stores to the foundry and sees that they are charged to the correct order number. The foundry recorder holds him responsible for the physical inventory of materials and he is expected to make frequent checks of actual quantities on hand against his records. All requisitions for foundry materials are first sent to him and he makes notations on them of the quantities

on hand and of any suggestions for substitutions from stores for the materials requested. A ledger card, Fig. 7, constitutes a perpetual ledger form for pig iron, scrap, etc., and a similar form, Fig. 8, is used as a record of supplies.

Record of the delivery of pig iron, scrap, coke, etc., from the yard to the foundry floor, is kept on a simple mixture report. After the material stores clerk has entered a mixture report, which is made out by the yard foreman, he sends it to the cost clerk, who files it away together with all the mixture reports for the month. When a pile of pig iron is exhausted, any existing balance on the ledger card is entered upon the inventory adjustment form, Fig. 2, together with any possible explanation of the discrepancy. These cards are filed for the month and are then journalized through the foundry cost journal.

Freight invoices on other supplies are posted on the ledger card if they form an appreciable part of the cost of the supply, otherwise they are absorbed in foundry burden as indicated by the foundry standing order list. Supplies are not charged to cost when they are received and the invoice passed, but are charged to cost when they are issued to the foundry, the balance on hand being carried as inventory. When an employee desires material of any kind he obtains a material delivery card, Fig. 9, from his foreman and presents it to the material stores clerk, who obtains the receipt of the person receiving the material. He enters the order number to which the material is to be charged and sends the materials delivered cards to the cost clerk, who files them under the order number. When minor materials not carried in stock are bought, a materials delivered card is issued for the entire purchase and the invoice is put through the foundry supplies account in the general ledger.

Substores of materials are kept when advisable in the various departments and a record of the replenishing of these substores is made on a materials delivered card. All materials delivered cards are priced and extended by the material stores clerk, using the average price of the undelivered material as shown by the ledger card so that, as nearly as possible, the cost may be absorbed when the supply is exhausted. Differences between the ledger cards and the physical inventory are handled as in the case of pig iron.

Purchasing Methods

Requisitions for purchases are made out on a simple requisition form. These are sent to the material stores clerk for his notation as previously described. The purchasing agent has a purchase order made out in triplicate. These orders are numbered serially and a spoiled copy is not destroyed but is filed. The original copy is signed by the purchasing agent and mailed to the vendor. The purchase order number is then placed on the requisition. The duplicate copy is first sent to the material stores clerk for entry on his stores card and is then filed by the purchasing agent in a drawer indexed to purchase order numbers so that this file will indicate materials on order. When the goods are received this copy is transferred to another order file called "purchase orders filled."

The triplicate of this order is sent to the receiving clerk as a notification to him of materials to be received. By the use of a cut carbon sheet the quantity ordered does not appear on this copy and must be filled in by actual count by the receiving clerk. He files these copies alphabetically to the vendor's name. This copy is returned to the purchasing agent and filed alphabetically to kinds of material. The back of the duplicate and triplicate copies is ruled to permit a record of partial shipments. There is also a place for recording the date of the invoice covering the partial shipments in order to minimize the liability of paying for material twice.

Production Order and Employment Clerk.—The specific duties of the production order and employment clerk are these: To write production orders covering castings, patterns and flasks, and plant orders; in consultation with the foundry superintendent to plan work ahead for the molders and core makers; to post production from the time tickets to the back of production orders; in connection with the foundry superintendent to make out the defective castings report for the defectives thrown out on the foundry floor; to assign clock numbers to the employees and to be in charge of the time clock cards ("In and Out"); to receive applications for employment; to keep employees' records; to keep piece rate records.

He is expected to relieve the superintendent of much of the details of production, particularly in regard to the precedence of orders and in pushing orders through to meet shipping dates. He should be so familiar with the character of work done and the capacities of the various molders that he can take much of the responsibility of assigning work to them. Knowing the amount of work ahead of the foundry and the requirements as to shipping dates he is able to furnish the customers' order clerk with promises of shipment of new work and of work in process.

From the customers' order, which has been sent to the pattern storekeeper and marked with the date on which patterns were tagged, the production order clerk makes out a production order, Fig. 10, in triplicate. He then files these orders in a drawer indexed to the customers' names and sub-indexed to the customers' order number. The orders are flagged in precedence with reference to the shipping date. This file shows the work ahead of the foundry. From this file and from the file of active patterns, the superintendent and the clerk select the work to be done, planning this as far ahead as is possible.

When the superintendent assigns the work to the various molders or core makers, he enters the workman's number on tags, making at the same time a memorandum list for the production order clerk. From this list the clerk enters on the three copies of the production order the molder's name and the date in the sand. He also makes out a productive labor ticket, Fig. 5, for each job. A separate order is made out for each lot of castings to be made from each pattern and these orders are numbered in sequence to afford a means for collecting the direct charges to each lot of castings. The pattern number entered on the production order serves to separate the charges against each lot of castings if it becomes necessary to list several patterns under the same order number. The productive labor tickets are filed in a rack which has a compartment for each molder, showing the work which has been assigned to each man.

The first copy of the production order is filed in a drawer indexed to production order numbers in such manner that the oldest order in process is in the front of the drawer. The second copy is filed in a drawer indexed to customers' names and serves as a cross-index for the production orders. The third copy is sent to the foreman

of the finishing department to notify him of work coming through and to aid him in identifying the castings to order number. When advisable a sketch of the pattern is made on the back of this copy to aid in identifying the castings.

From the productive labor tickets a record is posted on the back of the first copy, Fig. 11, of the number of pieces molded, the number poured and the number of defectives. Thus this form always shows the present condition of the order. On the back of the third copy is kept a record of the pieces finished. This record is not essential, but is of assistance in tracing a shortage between quantities molded and quantities shipped.

The superintendent goes over the defectives daily and passes on them as to the cause of defects and decides whether the molder is to be discounted and whether the castings are to be remade. This information is noted on a defective castings form, Fig. 12, by the production order clerk, the superintendent or a foreman. These defective castings reports are then sent to the production order clerk, who enters the quantity defective on the back of the first copy of the production order and sends the reports to the cost clerk. If the defective castings are to be replaced, an order to replace defective castings, Fig. 13, is made out in duplicate by the production order clerk. This order is of a distinctive color to indicate that the work must be pushed through the foundry so as not to delay shipment. The original copy is filed with the first copy of the production order and the duplicate with the second copy of the production order.

When the production order is completed, the third copy is returned by the finishing department to the production order clerk with the date completed noted thereon. The clerk then takes the other two copies from the file, notes the date of completion thereon and sends the first and third copies to the cost clerk, who checks the quantities shown on the orders against the quantities noted on his cost sheet and the quantities reported finished by the finishing department to ascertain if all castings made have been accounted for. The second copy he sends to the shipping clerk as notice that the order is completed.

Authority to make new patterns or flasks or to repair patterns on which it is necessary to obtain a complete cost is given on a form, Fig. 14. These pattern orders are made in duplicate and bear a prefix O to distinguish them from other production orders. The original is sent to the pattern shop and the duplicate to the cost clerk. When the pattern or flask is completed, the pattern foreman enters the date on the form and sends it to the pattern storekeeper, who signs it and then sends it to the cost clerk.

A plant order, Fig. 15, is made out in duplicate for shop castings or large repairs or additions to buildings, the cost of which it is desirable to obtain. These plant orders are numbered serially and bear the prefix P. If the order is for shop castings, the order is sent to the pattern storekeeper so that he may tag and deliver the pattern, and is then sent to the foreman of the finishing department so that the weight of the finished castings may be obtained. If for repairs or additions to buildings or equipment, the original is sent to the master mechanic. The duplicate copies are sent to the cost clerk and the originals are returned to him when the work is completed.

Sub-shop orders, Fig. 16, are issued by the superintendent, master mechanic or any authorized foreman for repairs to flasks, patterns, buildings or equipment for which it is not necessary to make a cost statement. These are delivered directly to the foreman or men who are to do the work and are returned after the work is completed to the person issuing them.

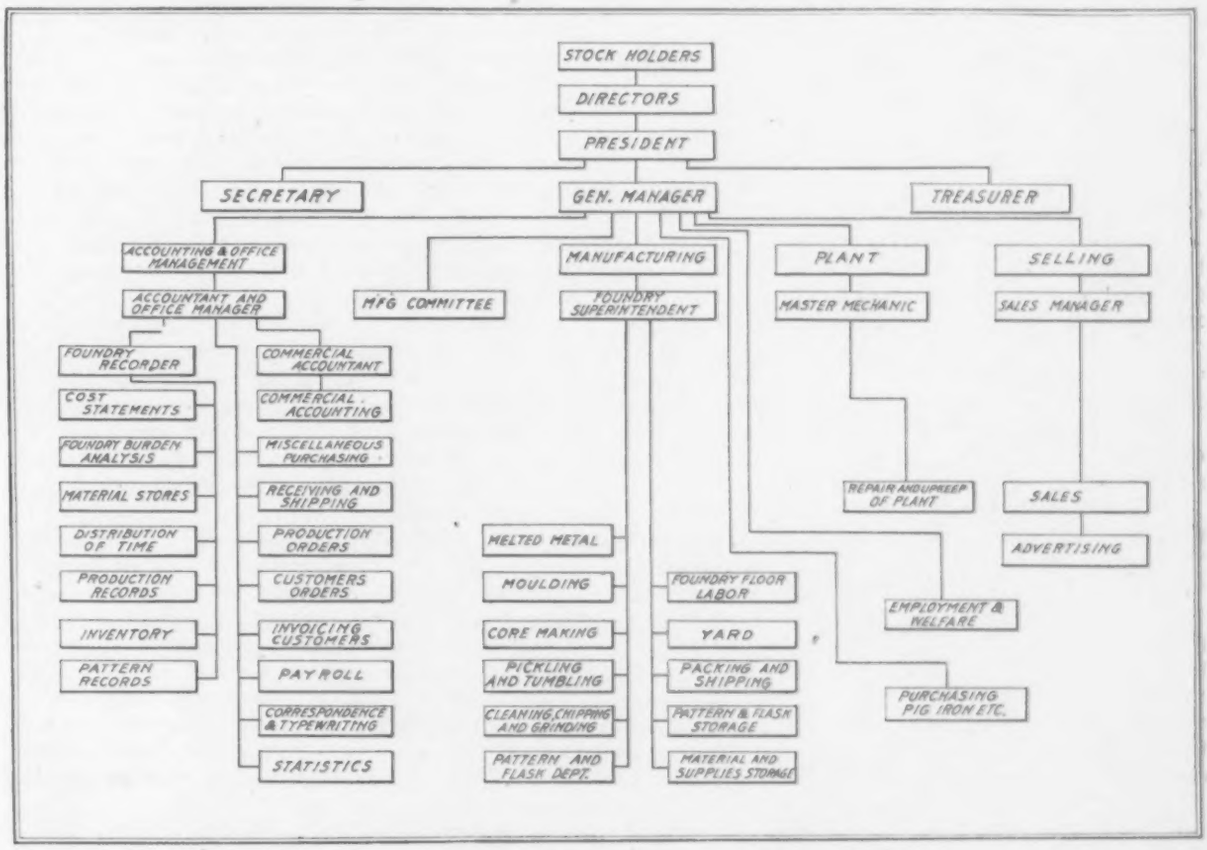


Fig. 1—Chart of Organization of the Parsons Foundry Company

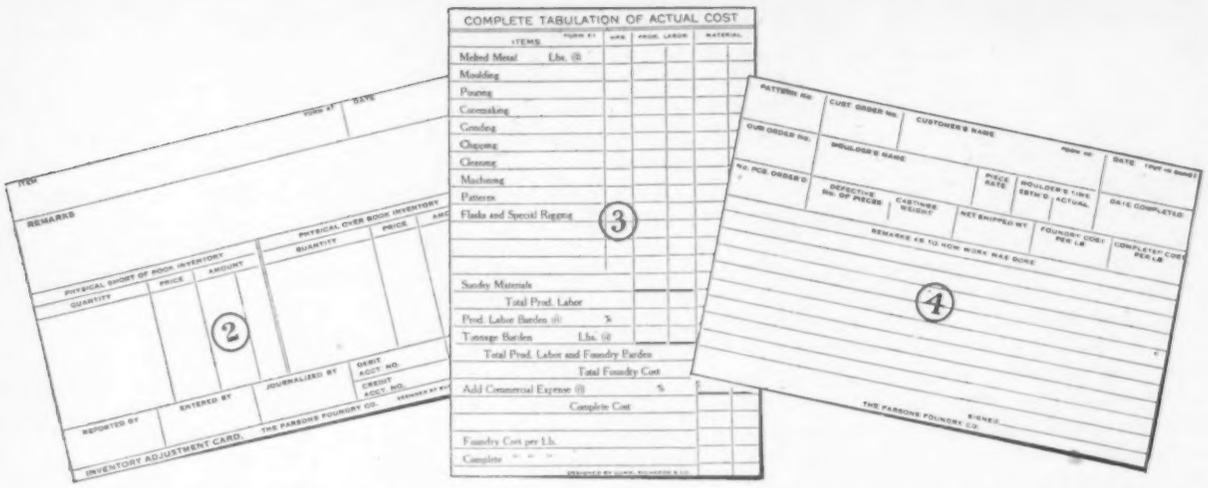


Fig. 2—Inventory Adjustment Card. Fig. 3—Cost Statement of Castings. Fig. 4—Reverse Side of Cost Statement for Castings

The distribution of employees' time is in charge of a clerk, who is responsible for the distribution of the time of both productive and foundry burden employees to production and foundry standing orders. He also records the time spent on foundry work by outside parties, not on the foundry payroll, for the cost of whose services a bill will be rendered to the company.

Distribution of Employees' Time

A productive labor ticket, Fig. 4, which has been partially filled out by the production order clerk, is used for productive labor or labor that can be directly charged to a production, pattern or flask, or plant order number. This form is printed with black ink and a similar form, Fig. 5, printed with red ink, is used for foundry burden labor or labor that can be charged to a foundry standing order. These tickets are used in connection with a Bishop time recorder.

When a molder calls at the time window for a new job, the time clerk removes his ticket from the rack, enters the date, stamps the starting time with the recorder and gives the ticket to the molder, who retains it until the molding is completed. When the molder turns in the time ticket, the time clerk enters on it the number of molds and the number of castings in the mold and stamps the finishing time with the recorder. In this plant the molders do not pour their own molds, this being done by a special gang. If there are patterns of more than one production order in a flask, the time is proportioned arbitrarily after consultation with the superintendent.

It is not generally practicable to have cleaners and laborers report to the time window when changing work, so the foreman is held responsible for recording the time on the reverse side of the ticket. At the end of the day the time clerk sorts the tickets to employees' numbers, making sure that he has tickets for each man on the payroll and that each ticket bears an order number, enters the elapsed time on the tickets and passes them to the payroll clerk.

Piece rates are established by the superintendent. Piece rate record forms are made out in duplicate by the cost clerk and approved by the superintendent. The original is sent to the payroll clerk and filed in a drawer indexed to customers' names and sub-indexed to pattern numbers. The duplicate is filed by the employment clerk in the same manner.

The Pattern Storekeeper.—The pattern storekeeper has charge of patterns and flasks, maintains the pattern records (no record is kept of flasks), and moves the patterns to the foundry floor. He collects them from the foundry when the work is done and sends them to the shipping department or returns them to the pattern storehouse. The record of receipt of patterns from a customer is kept in a blankbook. If customers' patterns are not marked and they will permit it,

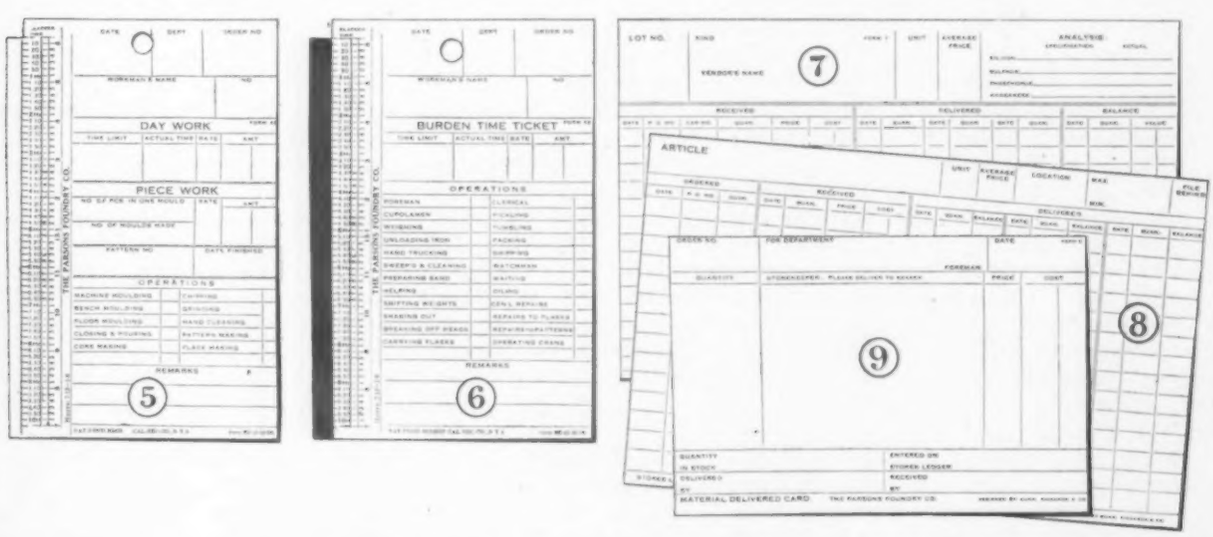


Fig. 5—Productive Labor Ticket, Printed in Black. Fig. 6—Burden Labor Ticket, Printed in Red. Fig. 8—Stores Ledger Supplies; same ruling on reverse side. Fig. 7—Stores Ledger, Pig Iron, etc.; same ruling on reverse side. Fig. 9—Material Delivered Card

the patterns are given a serial number with a prefix of the customer's initial. Patterns owned by the foundry but made for the work of a definite customer are given a serial number with a prefix X and a suffix of the customer's initial. Patterns for stock castings are given a serial number and a prefix Y. Patterns for plant castings are given a serial number and a prefix Z. Patterns and coreboxes that go with them are stored together.

Patterns that are not to be returned with the castings are entered on a pattern stores record card, Fig. 17. When advisable a sketch of the pattern with measurements is placed on the back of this card. These cards are filed alphabetically to owners and sub-indexed to pattern numbers. A cross-index of patterns is kept on standard 3 x 5 cards, indexed numerically to pattern numbers so that patterns can be readily located if only the number is known. The disposition of the patterns is noted on the pattern storekeeper's copy of the customer's order form. The shipping clerk sheet being perforated to form three individual reports. The duplicate is a plain sheet of white paper without perforations. The original receiving reports are sent to the material stores clerk. He delivers them to the purchasing agent, who first attaches them to the duplicate copy of the purchase order while awaiting the invoice, and afterward files them attached to the invoice.

In connection with the yard foreman the shipping clerk fills out a foundry report of product, Fig. 18, which is delivered to the cost clerk, who files all the reports for a month together.

Yard Foreman.—The yard foreman is responsible for storing and piling pig iron, scrap, coke, sand, etc., and for delivering such materials to the foundry or charging floor; for recording the weights of materials charged to the cupolas on the mixture report; for recording the weights of the sprue, heads, etc., returned to the cupolas from the foundry floor; for recording weights of defectives returned; and for reporting on the foun-

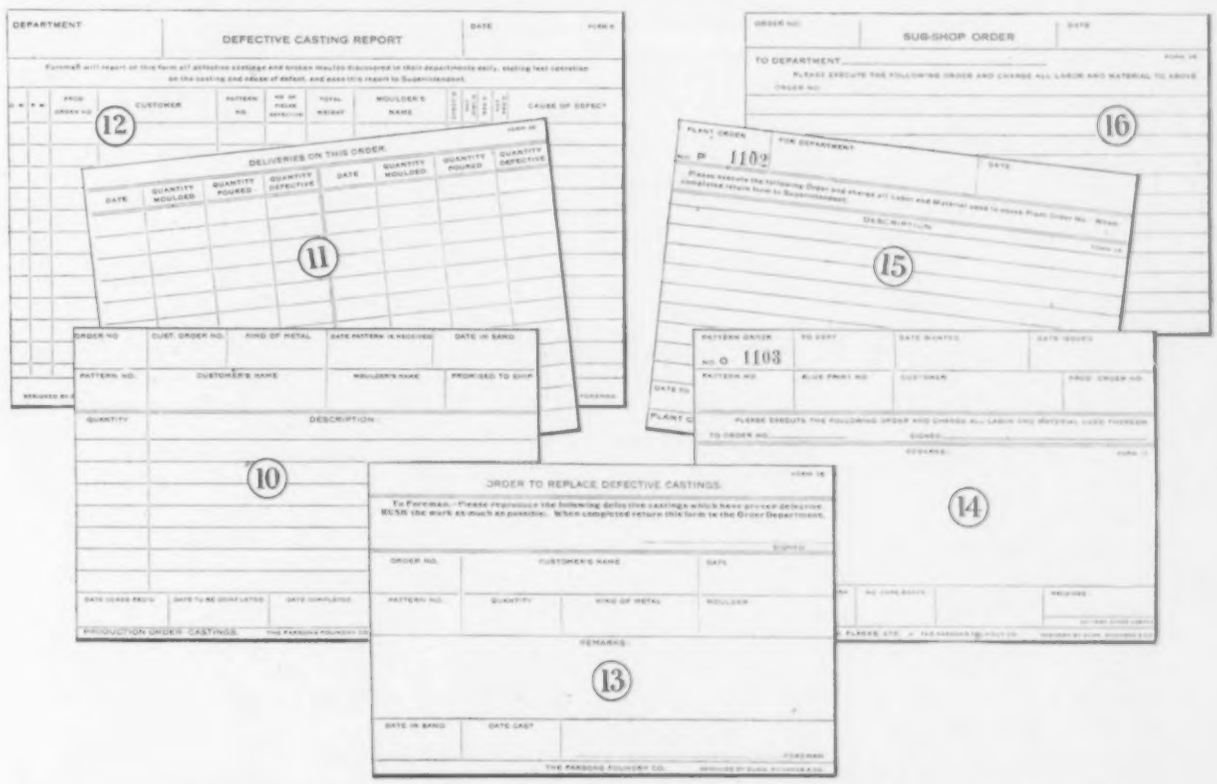


Fig. 10—Production Order for Castings. Fig. 11—Reverse Side of Original Copy of Production Order for Castings. Fig. 12—Defective Castings Report. Fig. 13—Order to Replace Defective Castings. Fig. 14—Production Order for Patterns and Flasks. Fig. 15—Plant Order. Fig. 16—Sub-shop Order

keeps a record made in quadruplicate of all patterns and coreboxes returned. The first copy goes to the pattern stores keeper for his information and then to the order clerk, who files it in order of the serial number; the second copy goes with the patterns to the customer; the third copy is receipted for by the truckman; the fourth copy is filed by the shipping clerk. The pattern storekeeper is held responsible for keeping the patterns in good repair and ready for use.

Receiving and Shipping Clerk.—The receiving and shipping clerk has these duties: Maintenance of a receiving record of all materials and supplies; shipment of castings and patterns; recording weight of production after sandblasting, cleaning or grinding of all castings; and the entering upon a defective castings report of all castings thrown out from the operations of sandblasting, cleaning, tumbling, grinding or shipping. The receiving record is made in duplicate, the original dry burden labor tickets the distribution to foundry standing orders of the time of the men under his charge.

Customers' Order Clerk.—The customers' order clerk, who is a stenographer and typist, is held directly responsible for the following: Typewriting customers' orders; extending and checking shipping sheets; posting shipments on the back of the order department's copy of the customers' orders; typewriting invoices to customers; typewriting purchase orders. He may use another stenographer on this work but is held responsible for the accuracy of the entries on these various forms.

Four copies of the customer's order are made out. The first copy, Fig. 19, is retained by the order department and filed by the customers' name. When the order is completed it is transferred to a filled order file. The second copy, which is identical except for a distinctive color, is sent to the

shipping department. When the order is completed, this copy is returned to the order department, where it is file indexed to the order number. The third copy is sent to the pattern storekeeper. When the patterns are tagged, it is sent to the production order clerk, who uses it to make out the production order. He then sends it to the cost clerk, who files it indexed to order number. The fourth copy, Fig. 20, is sent to the cost clerk, who files it according to order number when the order is completed. Fig. 21 shows the reverse side of the first two copies. The reverse side of the third copy is unused. The reverse side of the fourth copy is shown by Fig. 22.

Cost Items Not Chargeable Directly to Orders

Items of cost that cannot be charged directly to a production order number are charged to foundry standing orders. These orders are divided into three groups, each class of charges being given a distinguishing number, of which the first unit indicates the group to which it belongs. The three groups are: Direct charges to melted metal costs; foundry burden to be distributed on basis of productive labor; and foundry burden to be distributed on basis of pounds of good castings.

Direct Charges to Melted Metal Costs—In this group are included: Labor bringing in pig iron, weighing, labor of furnacemen, labor of repairs to cupolas and ladles, repair materials, fuel, proportion of power cost to operate blowers, etc., depreciation of cupola and other equipment, other charges.

Foundry Burden to Be Distributed on Basis of Productive Labor—In this group are included: Repairs and care of plant which is subdivided into land, building, building equipment, machinery, tools and utensils, patterns, flasks, industrial railway and equipment, railroad spur, and sundry repair materials not otherwise charged; master mechanic; proportion of power, heat and light cost not otherwise charged; water; oil, waste and other supplies for power equipment; electric lamps; superintendence; foremen and assistants; factory accounting; storeroom clerks and laborers; shipping clerk; sorting and packing labor; watchman; waiting for work; shipping materials and supplies; general foundry expense materials, such as molding tools, shovels, brooms, grinding wheels, etc.; labor and materials for shop castings not otherwise charged; cartage; chauffeur; experimental expense; incoming freight and express charges not added directly to cost of materials; insurance; taxes; liability insurance; depreciation; interest on investment; reserve for difference in inventory; loss on returned castings; other charges.

Foundry Burden to Be Distributed on Basis of Pounds of Good Castings—In this group are included: Unloading and piling pig iron; preparing sand; recovering foundry scrap; sweeping and cleaning; unloading and storing of coke, scrap, sand, etc.; foundry floor labor; labor in connection with coremaking not otherwise charged; sandblasting labor; tumbling labor; labor in connection with grinding and cleaning not otherwise charged; operating cranes; molding sand; core sand; facings; oven fuel; charcoal; core floor; core oil; core wire; other core room supplies; material for sandblasting or pickling castings; other charges.

COLLECTING DATA ON MELTED METAL COSTS

A daily cupola report, Fig. 23, is in use to

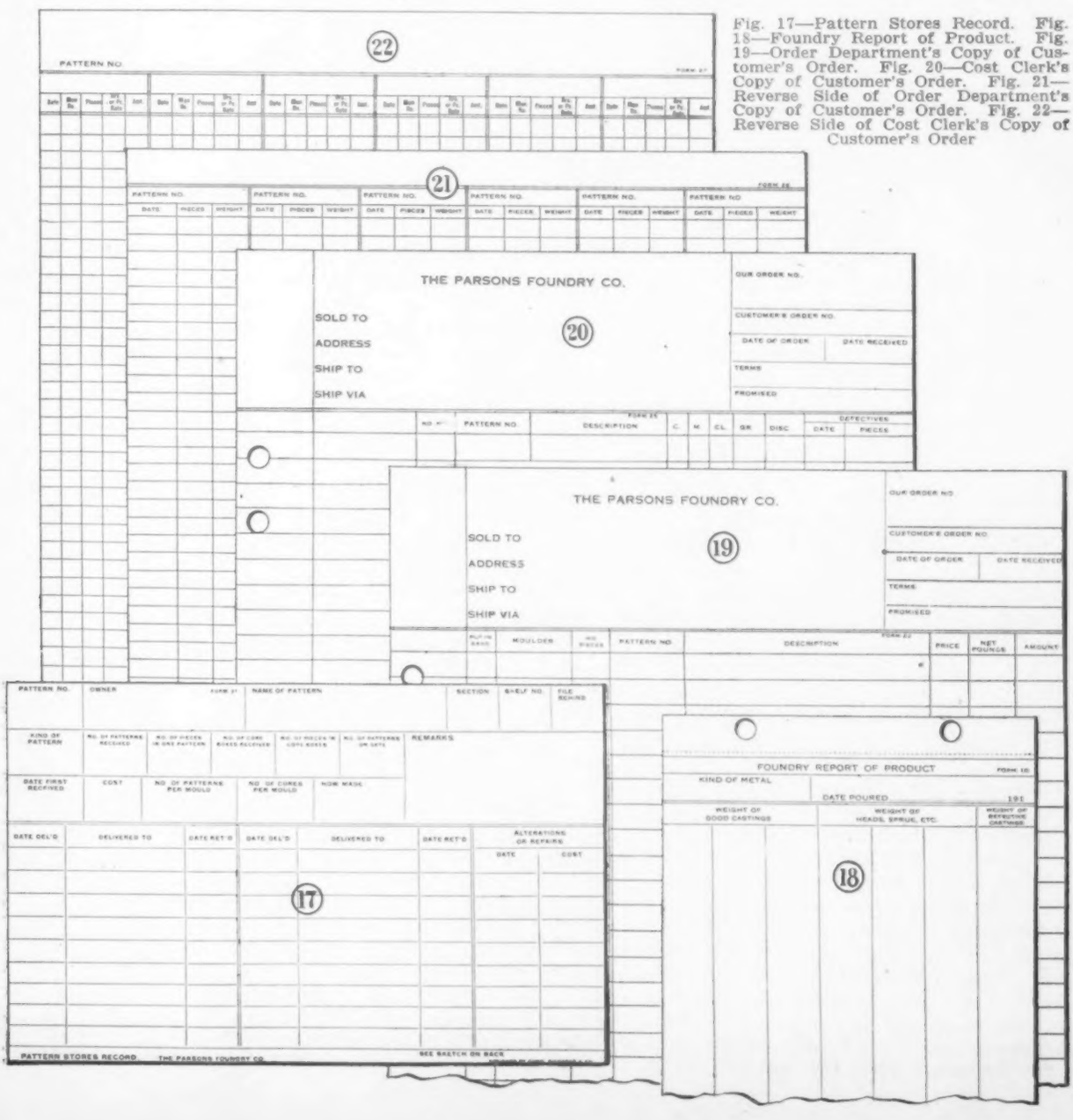


Fig. 17—Pattern Stores Record. Fig. 18—Foundry Report of Product. Fig. 19—Order Department's Copy of Customer's Order. Fig. 20—Cost Clerk's Copy of Customer's Order. Fig. 21—Reverse Side of Order Department's Copy of Customer's Order. Fig. 22—Reverse Side of Cost Clerk's Copy of Customer's Order

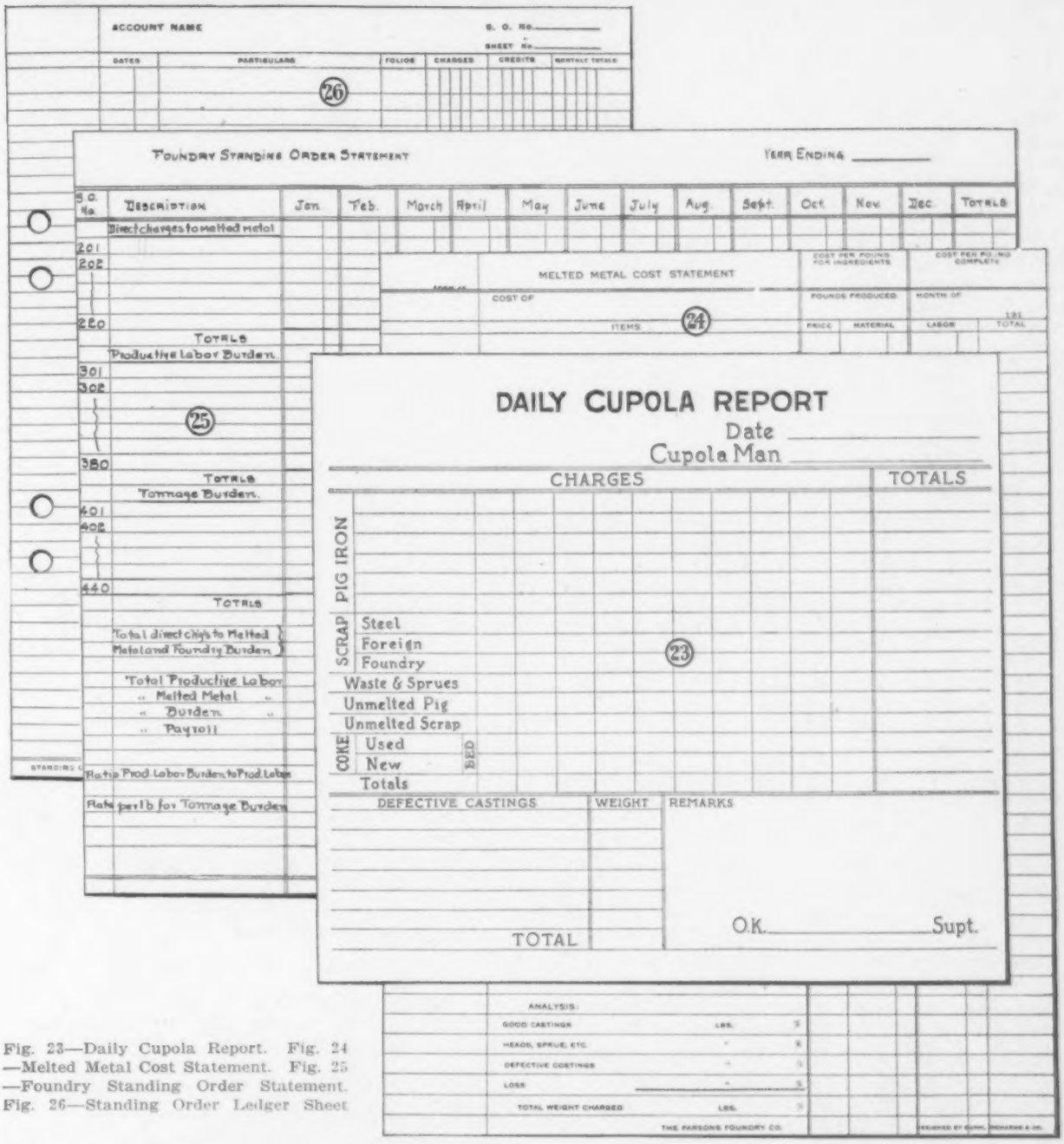


Fig. 23—Daily Cupola Report. Fig. 24—Melted Metal Cost Statement. Fig. 25—Foundry Standing Order Statement. Fig. 26—Standing Order Ledger Sheet

gather the data of pig iron, scrap, waste and sprues, and coke used in each heat. This form also has a space for the record of defectives. At the end of the month a metal melted cost statement, Fig. 24, is prepared. The number of pounds of the various metals charged to the cupola are priced at the purchase price plus freight, and the total number of pounds charged to the cupola divided into the total material cost gives the price per pound of the ingredients. The total number of pounds of waste and sprues charged to the cupola is priced at the same cost per pound. The total of these items gives the total number of pounds charged to the cupola and the total material cost.

The total weight of heads, sprue, etc., and the weight of defective castings, figured at the cost per pound previously used, form a credit to the material cost just obtained. The difference represents the net material cost for the melted metal. To this is added the direct charges to melted metal cost as scheduled in the first group of the foundry standing orders. The total of all the items divided by the total weight of good castings for the month gives the cost per pound of metal in good castings for the month. In applying this cost to the complete cost statement, the cost per pound of melted metal is increased slightly (between 1 and 2 per cent) to make up for the slight loss in weight due to the cleaning operations.

FOUNDRY BURDEN ANALYSIS

The total monthly charges under the second group of the foundry standing orders is distributed to the cost statement of each production order in proportion to the amount of productive labor charged to each lot or order. This distribution is accomplished by means of a percentage ratio of the total productive labor for the month to the total of the monthly charges to this group of standing orders.

The charges to the third group of foundry standing orders are distributed to the cost statement of the various productive orders by means of a rate per pound obtained by dividing the total monthly charges to the third group of standing orders by the total pounds of good castings for the month.

The sources of entries to the standing orders are from the burden labor tickets, material de-

livered cards, invoices chargeable directly to foundry burden, journal vouchers from the commercial accountant covering such items as depreciation, reserves for taxes, insurance, etc., and from the distribution of petty cash.

In making up the schedule for the monthly charges for depreciation the following yearly rates of depreciation are used: Land, none; buildings, 3 per cent; building equipment, 10 per cent; machinery, 7½ per cent; tools and utensils, 20 per cent; patterns, 20 per cent; flasks, 25 per cent; office furniture and fixtures, 10 per cent; industrial railway and equipment, 10 per cent; railway spur, 10 per cent.

For collecting the charges (monthly) to the foundry standing orders, a standing order ledger, Fig. 26, is maintained. A separate sheet is used for each order. To these sheets the payroll clerk posts from the payroll analysis sheets the total monthly charges to each standing order. He also opens a similar sheet, filed in the same binder, for each item in the productive labor group so that the total monthly posting of the labor items must agree with the total payroll for the month. He also posts from the materials delivered card the total charges for the month for each standing order. The cost clerk posts the charges coming from the commercial accountant. From the monthly totals of this ledger is obtained the percentage ratio for the foundry burden to be distributed on the basis of productive labor and the rate per pound for the foundry burden to be distributed on the basis of pounds of good castings.

As this rate and percentage for the previous month is not determined until the forepart of the next month, and as cost statements are being compiled currently during the month, it is necessary to use a predetermined rate and percentage in applying foundry burden to cost statements. The rate and percentage used are not the current month's, but are based upon the cumulative rates and percentages for several months. They are set by the commercial accountant, who endeavors to keep them as constant as possible, raising or lowering them only as the balance of burden unabsorbed, as shown by the foundry burden controlling account in the general ledger, is abnormal to the product in process. At the end of the month the charges for the various foundry standing orders are entered on a foundry standing order statement, Fig. 25. This has vertical columns for each month of the year and a yearly total, and each item of the three groups of standing orders has a line by itself. Upon this sheet also appears other valuable information for purposes of monthly comparison, namely: Total direct charges to melted metal and foundry burden; total productive labor; total melted metal labor; total foundry burden labor; total payroll; ratio of productive labor burden to productive labor and rate per pound for tonnage burden.

Compiling Cost Statements

Labor tickets, as has been stated, are eventually sent to the cost clerk. On the back of his copy, Fig. 22, of the customer's order form, he enters daily the data from these tickets, using a separate column for each productive operation and listing productive labor for each pattern number separately. The number of defective pieces and the molder's discount are also entered so that this form shows the number of good pieces and the labor cost to date.

When the order is completed, as shown by the return to the cost clerk of the three copies of the production order, he proceeds to make out a cost statement, Fig. 3. The labor cost is transferred from the copy of the customer's order form to the labor column on this form against the designated items of productive labor. The number of good pieces shown by the back of the customer's order form, Fig. 22, must agree with the number reported on the back of the original copy of the production order, Fig. 11, and both must agree with the number reported on the cost department copy of the customer's invoice. Failure to agree shows that some defectives are unaccounted for.

The first item on the cost statement is determined by multiplying the number of pounds shipped by the cost per pound as shown by the melted metal cost statement. It is entered in the material column. The item "Flasks and Special Rigging" includes materials used in repairing flask and special rigging used in molding, and is entered in the material column. Sundry materials, such as chaplets, etc., are similarly treated. To the productive labor total is applied the percentage for productive labor burden. To the pounds shipped is applied the rate per pound for tonnage burden. The total productive labor and foundry burden is then carried into the material column, the total of this column then giving the total foundry cost or cost at the foundry door. To this is added the commercial expense, giving the complete cost.

On the reverse side of this form, Fig. 4, is noted complete data regarding the order, with remarks as to how the work was done and suggestions as to the method to be used in the future. The statements of cost of patterns and flasks and of plant orders are compiled in a similar manner, but are somewhat simpler, as is shown by Fig. 27. The same productive labor burden percentage is used on these statements as is used on the castings cost statement. The tonnage burden, of course, does not appear on these compilations.

Compiling Cost of Sales

An unusual feature of this system is the compilation of costs on the cost department copy of invoices to customers, Fig. 28, even though the invoice be for a partial shipment. This is the factor necessary to enable the accounting department to get out a monthly profit and loss statement. If the shipment is complete, the cost is obtained from the regular cost statement described in the preceding paragraph.

If the shipment is a partial one, a cost summary of sales, Fig. 29, is opened for each pattern on a production order. On this form are several vertical columns, one for each partial shipment. Most of the features of this form are made clear by the illustration. If sundry materials are an appreciable item, a certain proportion is entered against the partial shipment. When the order is completely shipped, the total labor charges against the partial shipments must agree with the totals compiled on the back of the cost department's copy of the customer's order, Fig. 28, and on the complete cost statement shown in Fig. 3. The total foundry cost must also equal the total on the complete cost statement. If there is a difference it is charged to the last shipment. If the total foundry cost on the cost summary of sales is greater than on the complete cost statement, the difference is entered on an inventory adjustment card and journalized through the foundry journal at the end of the month.

The indeterminate factor which might produce this difference is that the number of defectives is

not definitely known until the order is completed. It will be noted that the labor cost of any order is posted as fast as the work is done and that a cost is placed against castings as fast as they are shipped, even though the order is not complete. This enables the management to determine the history of any order and its cost to date at any time.

Estimates for new work are compiled on the regular cost statement, Fig. 3, which is stamped "Estimated Cost." If the job is accepted, the cost clerk enters on the face of his copy of the customer's order the piece rates or the day wage and the schedule of production as estimated by the superintendent so that when the labor tickets are turned in he may check them against the estimates.

The system outlined in the foregoing paragraphs was designed and installed by Gunn, Richards & Co., production engineers, New York.

The Foundry and Equipment

The main building of the Parsons Foundry Company is a steel and concrete structure, 110x 300 ft., with a large proportion of the walls of glass. The entire length of the middle of the building has a monitor roof which forms a crane bay in which are located two traveling cranes with 50-ft. bridges. The side floor opposite the cupolas is equipped with two 2-ton electric traveling cranes and another of the same type serves the charging floor and the bench molders' balcony.

A section, 160 ft. long, over a portion of the side floor on the cupola side of the building is raised to two stories to form a charging floor and a balcony for bench molders. Two hatchways in this floor permit the raising of loads from below by the crane serving the balcony.

Two cupolas are installed, the larger one a Paxson cupola with an 84-in. shell and rated at 20 tons an hour.

The present molding machine equipment, which is being added to as fast as machines can be secured, consists of one Herman jarring and roll-over machine of 6,000-lb. capacity; one Herman jarring machine, 60x72 in.; three Mumford jarring machines, 18x24 in., 20x30 in., and 30x42 in.; and nine squeezers. There are four motor-driven riddles and one motor-driven core sand mixer. A concrete pit, 17x20x5 ft., is located in the main craneway. One of the illustrations shows an interesting casting cast in this pit with 77 cores.

Clarence E. Bilton is president and treasurer of the company, Charles A. Place is superintendent, and Robert W. Ellingham is sales manager.

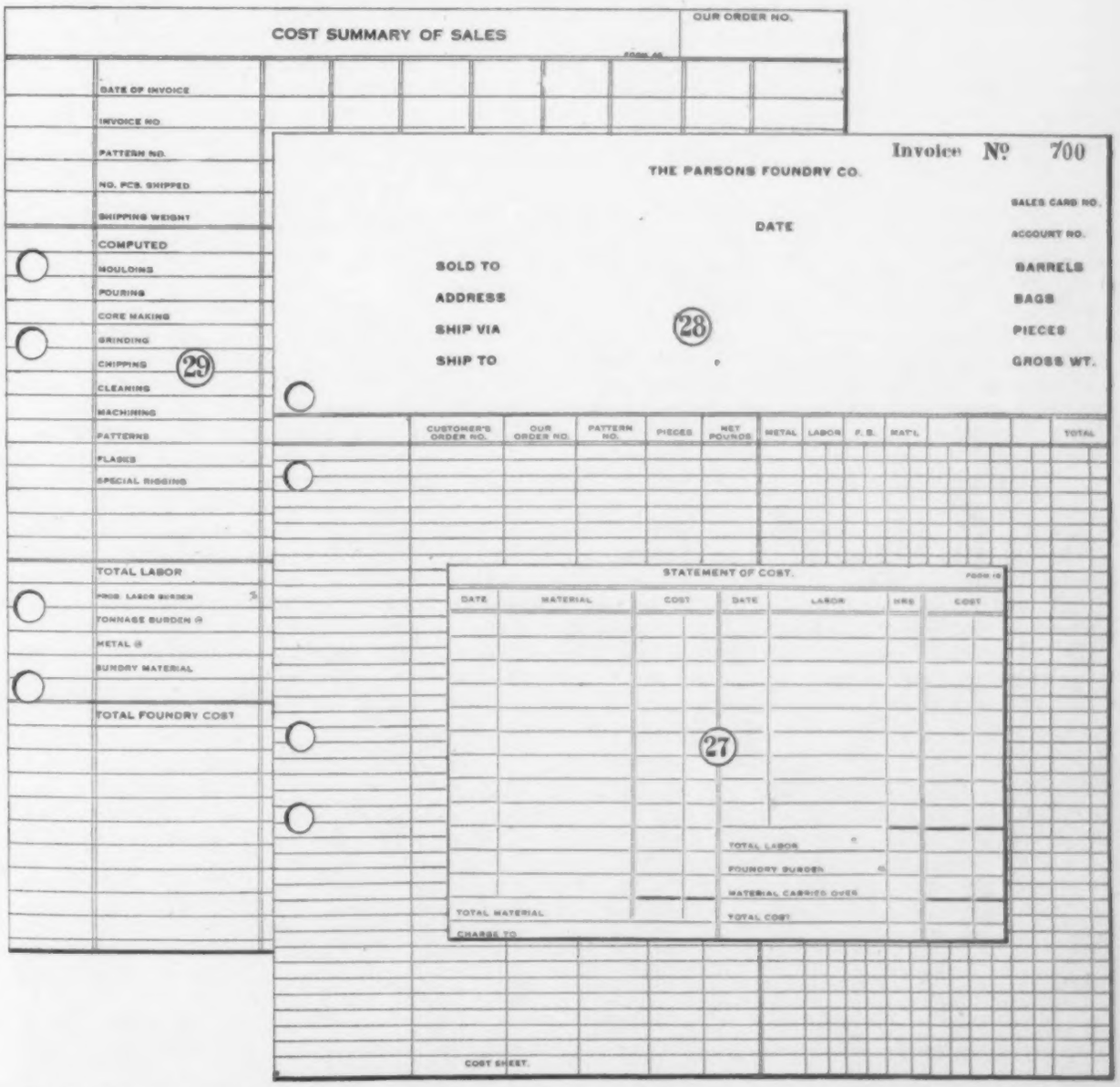
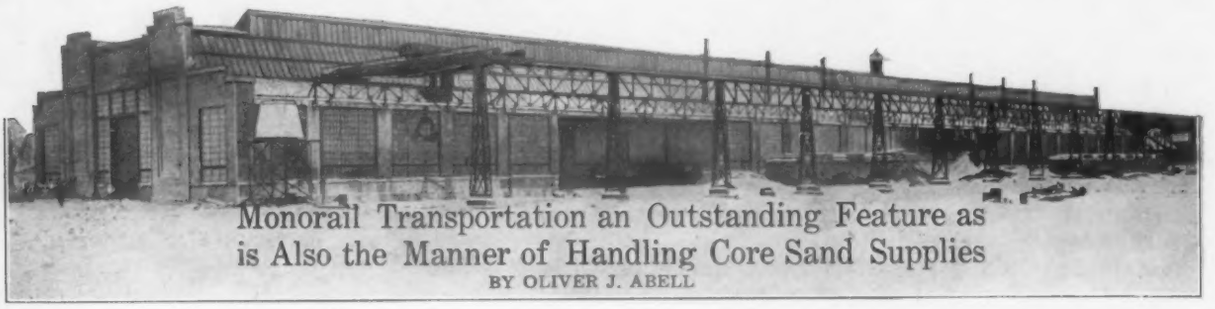


Fig. 27—Cost Statement on Reverse Side of Production Order for Patterns. Fig. 28—Shipping Clerk's Copy of Customer's Order. Fig. 29—Cost Summary of Sales

Nash Motors Company Foundry at Kenosha



Monorail Transportation an Outstanding Feature as is Also the Manner of Handling Core Sand Supplies

BY OLIVER J. ABELL

THERE are intervals, usually at the inception of a business or immediately preceding some stages of expansion, when attention focuses on the building and its equipment, almost to the exclusion, temporarily, of the consideration of commercial and operating problems. This is so, primarily, because of the fundamental importance of both building and equipment. Secondarily it is so, because much of the pride of proprietorship and much of the self-advertising of an enterprise center about the building and the equipment. It is an essential to subsequent satisfaction and operating economy that well crystallized ideas of what will best serve a business in the matter of fixed plant be had. The following description of a new gray iron foundry, just completed for the Nash Motors Company, Kenosha, Wis., presents a design and construction representative of what an unrestricted, engineering survey of the problem of producing from 50 to 70 tons per day of automobile castings would provide for that purpose.

The foundry was contracted for by the Thomas B. Jeffery Company and was nearly completed at the time ownership was transferred to the Nash Motors Company. It was designed and the construction supervised by the Arnold Company, Chicago. The general scheme of the job was formulated in the endeavor to eliminate manual operations in the handling of all materials, to provide exceptional lighting, ventilating and sanitary conditions and to incorporate into the construction of the building an enduring character.

The building is a steel and concrete structure 620 ft. long and 120 ft. wide, extending from east to west. The longitudinal walls are of reinforced concrete with pilasters 20 ft. on centers, 4 ft. wide, having footings of reinforced concrete proportioned for an earth load of 35 lb. per sq. ft. The fact that the soil at a depth of 8 ft. below the surface develops into quicksand necessitates keeping these footings as near as possible to the surface and they were only carried down slightly over 4 ft. or sufficient to get below frost line. Between the pilasters, spandrel walls of reinforced concrete, 16 in. thick, extend to a height of 4½ ft. above the floor line. The entire space between the pilasters and extending from the top of the spandrel walls to the lower chord of the roof trusses, a distance of 22 ft. above the floor line, is hung with steel sash and glazed with ribbed glass. The west wall is of a temporary nature designed so that a future extension of 140 ft. may be made to the building at minimum expense; and it is of asbestos protected corrugated steel, supported by steel framework. The roof trusses are of steel supported at the outer walls by the pilasters and along the center line of the building by a single row of steel columns. The roof is of the improved monitor type, illustrated in Fig. 2, covered with Federal cement tile and having monitor sash furnished by David Lupton & Sons, Philadelphia, which, divided into six sections, extends the entire length of the building on both sides and is motor operated.

The general layout of the building is illustrated in Fig. 1. The main entrance is in the center of the east end protected by a rolling steel shutter door. Through this an extension of the works' main side track from the east enters the building and passing across the northeast corner emerges on the north side and extends along that side to the west end, furnishing a means of bringing in coke, sand and iron to the storage yard. This track is a means also of conveying castings from the cleaning rooms to the plant machine shops located some distance east of the foundry.

Special attention has been paid to providing adequate light and means of ventilation. To this end, the entire side and the end of the building with exception of the pilasters is glass inclosed, and the monitor roof is provided with extra large sash on both sides to give ample light to the center of the building. All of the monitor sash as above described is motor operated so that it can be opened and the lower section of all wall

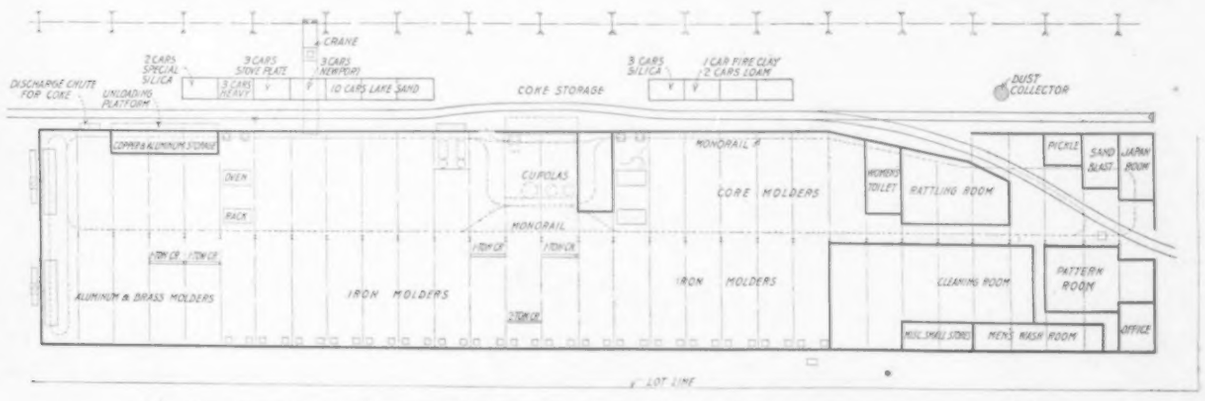


Fig. 1—General Floor Plan of the New Foundry of the Nash Motors Company, Kenosha, Wis.

sash is pivoted for the same purpose, so that an ideal chimney effect is produced, air being admitted through the wall sash and noxious fumes and gases carried out through the monitor sash.

Artificial light is provided by means of 200-watt nitrogen-filled lamps with deep bowl metallic shades suspended from the roof trusses and spaced approximately on 20-ft. centers throughout the entire building. The side walls are also equipped with two 100-watt receptacles with angle reflectors on each pilaster and located about 8½ ft. above the floor line. Additional local lights are provided wherever desirable. All light and power conductors are carried in conduit and the various groups of lights are controlled from centralized panel boards located at readily accessible points.

Heating is by means of two American Blower Company blast coil fan sets located along the south wall, each set having a capacity to heat half the building. They are also interconnected. These heaters are supplied with exhaust steam from the main works and the heated air is distributed by means of underground concrete conduits extending along the north and south walls of the building. From these conduits sheet steel risers are brought up at each pilaster, from which the air is ejected into the room at a height of about 8 ft. above the floor line and in such manner as to blanket the cold outer walls. The heating system is designed so that all air may be taken from outside, or all from the inside for recirculation, or such proportions between the two sources as may be desired.

Steam and electric power is received from the main plant, the conduit and pipe being installed in an underground tunnel 6 ft. 9 in. high by 5 ft. 6 in. wide, extending from the east end of the foundry to the older portion of the plant, a distance of about 200 ft.

A complete monorail system consisting of 12-in. I-beams with the necessary hand-operated switches forms a loop along the north wall of the building and along the center line extending east and west, with cross-overs at several points and with a stub extending outside the building to the north, so that raw material may be received from the outside, if desired, and may be distributed to any point on the charging platform of the cupola, along the core benches, in front of the cupolas, over the crucible furnaces, along the front of the molding bays and to the cleaning room. This monorail is indicated in Figs. 1 and 2. The system is equipped with two 3-ton Shepard electric monorail hoists with cab and one 1-ton floor-operated electric hoist. Specially designed ladle holders equipped with 1-ton bull ladles have been made for attachment to the 3-ton hoists, so that molten iron may be received directly from the cupola and delivered to the small Brillion ladles suspended from the 1-ton cranes in each molding bay. Finished castings also can be picked up from the end of each molding bay and transferred to the cleaning rooms by this system.

A subsidiary monorail system, hand-operated, is provided in connection with the pickling tanks, sand-blast room and japanning room, so that castings can be received in the cleaning room, mounted upon this system and put through the pickling tanks, sand blasting and japanning ovens without being removed from the system. The entire installation of conveying apparatus is designed to reduce the manual conveying of material to the minimum.

The iron melting equipment is centrally located. The cupolas are three in number, having capacity of 10, 5 and 3 tons each, the two smaller brought over from the old foundry and the largest furnished by the Whiting Foundry & Equipment Company. The charging platform is a steel structure with its floor 15 ft. above the foundry floor line and extending from a line 37 ft. inside the north wall to a line 8 ft. outside the building wall. Access from the outside portion to the inside is had by means of sliding metal doors. The design of the charging platform is such that pig iron, coke, etc., may be delivered from the storage yard by means of the outside crane directly to buggies on the exterior projection of the platform. In passing to the platform within the building, the charging buggies are wheeled on a traveling scale, just within the building wall on a depressed track, bringing its platform flush with the charging platform floor. After weighing the materials are wheeled to the cupola. The cupola blowers, two in number, are located on the foundry floor immediately in the rear of the cupola and under the charging platform.

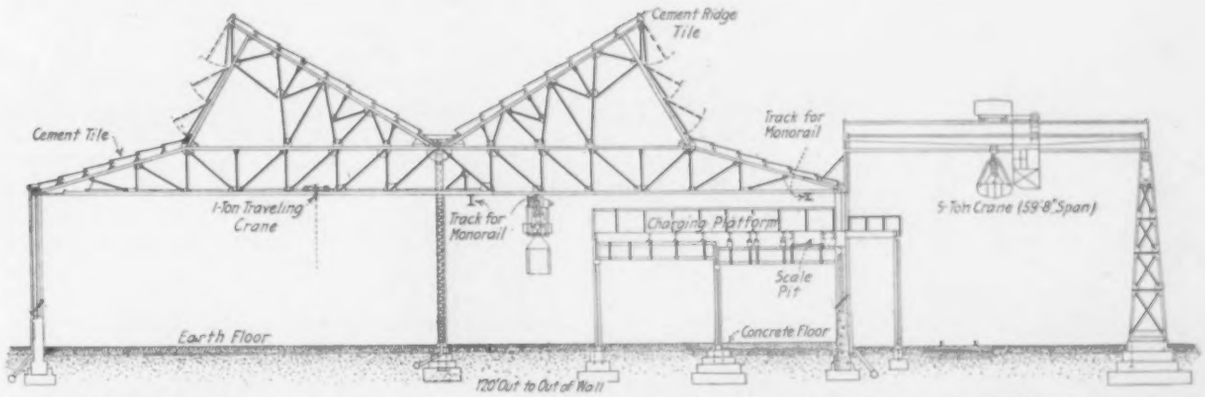


Fig. 2—Roof Construction and General Design of the Buildin of the Nash Motors Company, as Shown by the Cross-Section

Directly opposite the cupolas are seventeen molding bays for gray iron castings, each bay extending 60 ft. from the south wall to the center line of the building and being 20 ft. wide. The floor of these bays is surfaced with about 4 in. of clay and each bay is served by a 1-ton hand-operated Brownhoist crane hung on the lower chords of the roof trusses. Suspended from each of these cranes is a Brillion Iron Works pouring device with a 750-lb. ladle. The hot metal is brought to the pouring ladles, as stated, in a 1-ton bull ladle which is hung direct from the monorail trolley by means of a rigid latticed steel construction. This construction is novel in that the ladle is suspended from the trolley frame through a hinged connection rather than from the hoist and possibility of the ladle's dropping is eliminated.

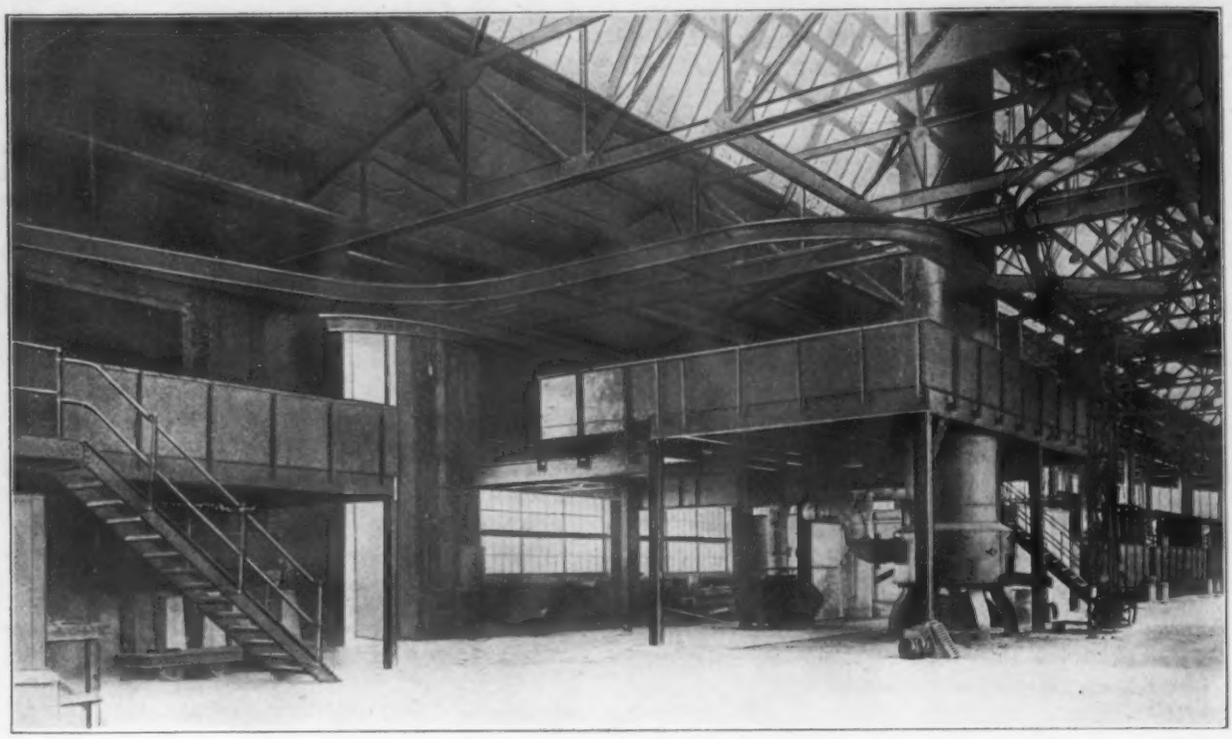


Fig. 3—Melting Equipment in the Foundry of the Nash Motors Company. Two additional cupolas are yet to be installed. At the left are shown the provisions for sand mixing

Immediately west of the iron molding bays are four similar bays devoted to the molding of brass, aluminum and other composition castings. In the center of the west wall is a door giving access to the rear of the lot, for the disposal of refuse sand. Flanking this door on each side are the crucible pits, each affording accommodation for 12 crucibles. The center working aisle 8 ft. wide extends the entire length of the building just north of the center columns.

The work of this foundry involves the use of an exceptionally large number of cores. Roughly estimated the weight of core sand used will approximate one-half of the castings tonnage. The extensive provision for core-making indicated in the illustrations is thus occasioned. Six bays on each side of the cupolas are occupied by the core-making equipment, the section on one side providing for the making of small cores with women operators and the other for the larger cores.

The core benches are each 5 ft. square, two to each bay, placed against the north wall. Above each bench is suspended an individual core sand bin designed to hold about one day's supply of prepared sand, which is fed by gravity directly from the bin to the core bench, as required. In front of these benches and separated from them by a 10-ft. aisle, are three batteries of double

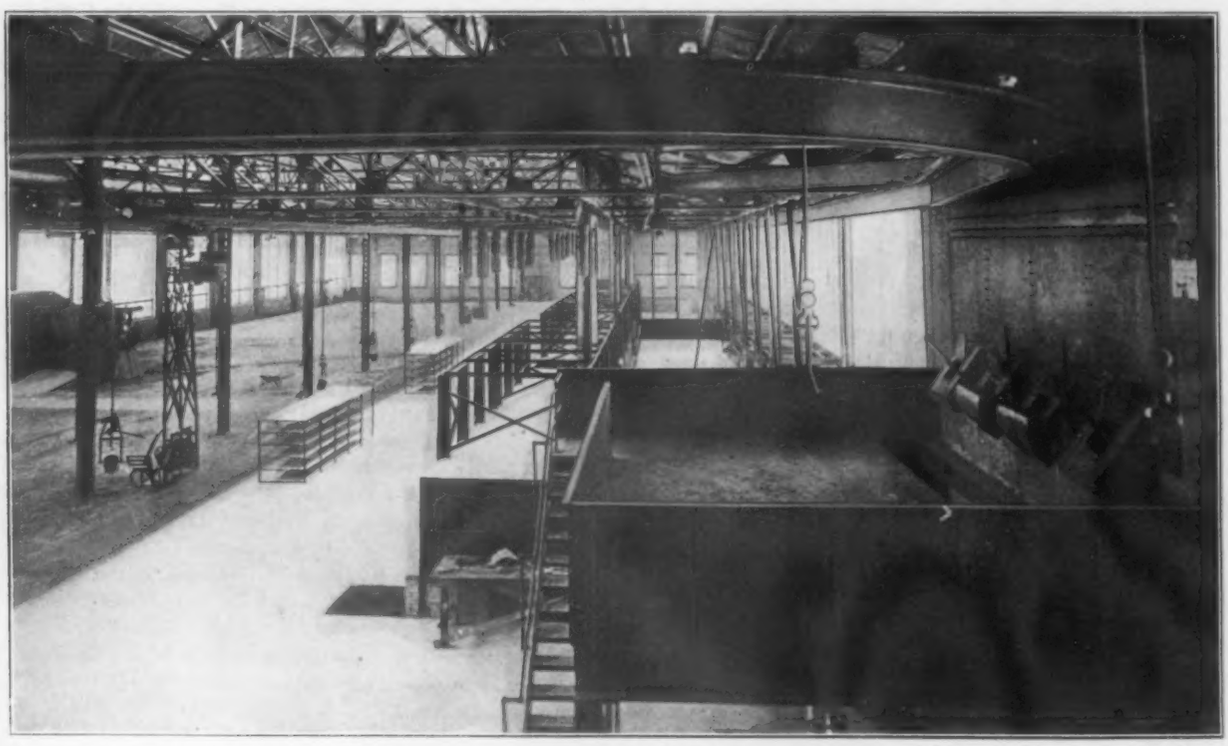


Fig. 4—West End of the Foundry Looking from the Charging Floor of the Cupola. In the foreground are shown the sand spouts and mixing platform

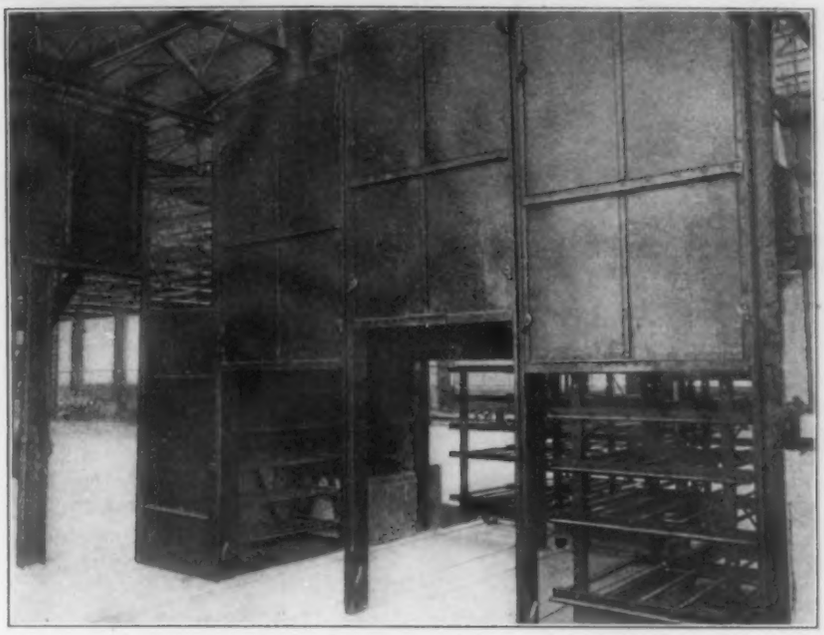


Fig. 5—The cars enter one side of the core ovens and deliver the baked cores at the opposite

easy range of the monorail system for distribution to the mold floors as required.

Access to the outside of the building on the north is afforded by a set of double doors in the bay next west of the charging platform. The succeeding bay is occupied by the sand-mixing apparatus. Steel sand pockets are provided on the outside wall to receive sand from the outside storage, these pockets holding about three days' supply of sand. From these pockets the sand is delivered by gravity to a measuring bucket on the sand-mixing platform, thence by gravity to the mixers, from which it flows to portable bottom dump buckets which are conveyed by the monorail system to the individual bins above each core bench. An annunciator is placed above the sand-mixing platform with sig-

Fig. 6—The Craneway Serving the Raw Material Storage Yard, the Centrally Located Concrete Sand Bins, the Inclined Hopper for Sand Going to the Mixer and the Extension of the Charging Floor Platform for the Receipt of Pig Iron and Coke for the Cupola

core ovens, each battery being 36 ft. long by 9 ft. deep by 7 ft. high, having a furnace at each end designed for coke firing and containing apartments for six core cars. Each battery is provided with a center partition so that either end may be fired independently of the other.

The core ovens are constructed of steel framing, with walls, roof and doors of channel frames double paneled with No. 16 gage steel sheets, the hollow wall between the paneling being filled with infusorial earth. Sliding doors are provided on each side of each compartment so that the core cars may be filled while standing between the core benches and the ovens, rolled into the ovens and thence out on the other side, where the cores are removed from the cars and placed upon storage racks within

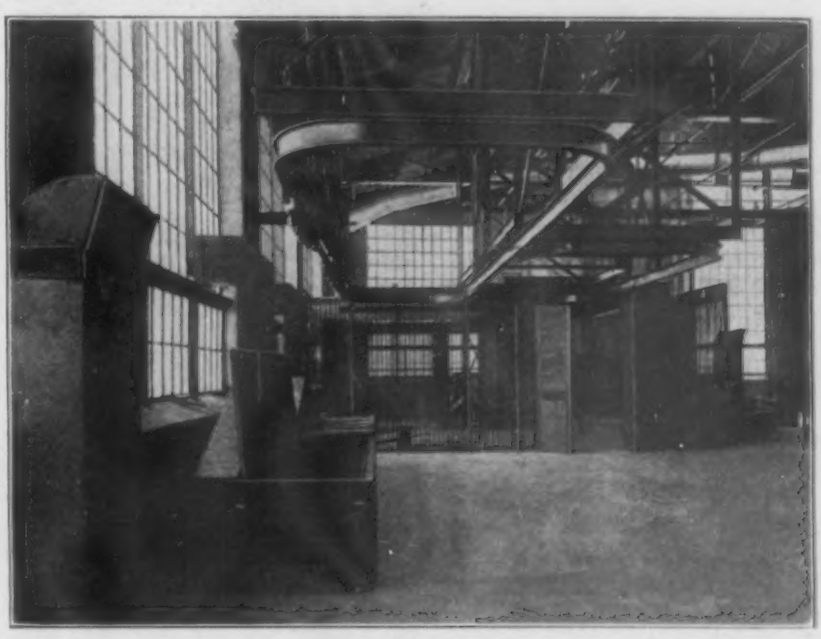


Fig. 7—The Pickling Tanks, at the Left, the Sand Blast Room and Beyond it the Japanning Ovens

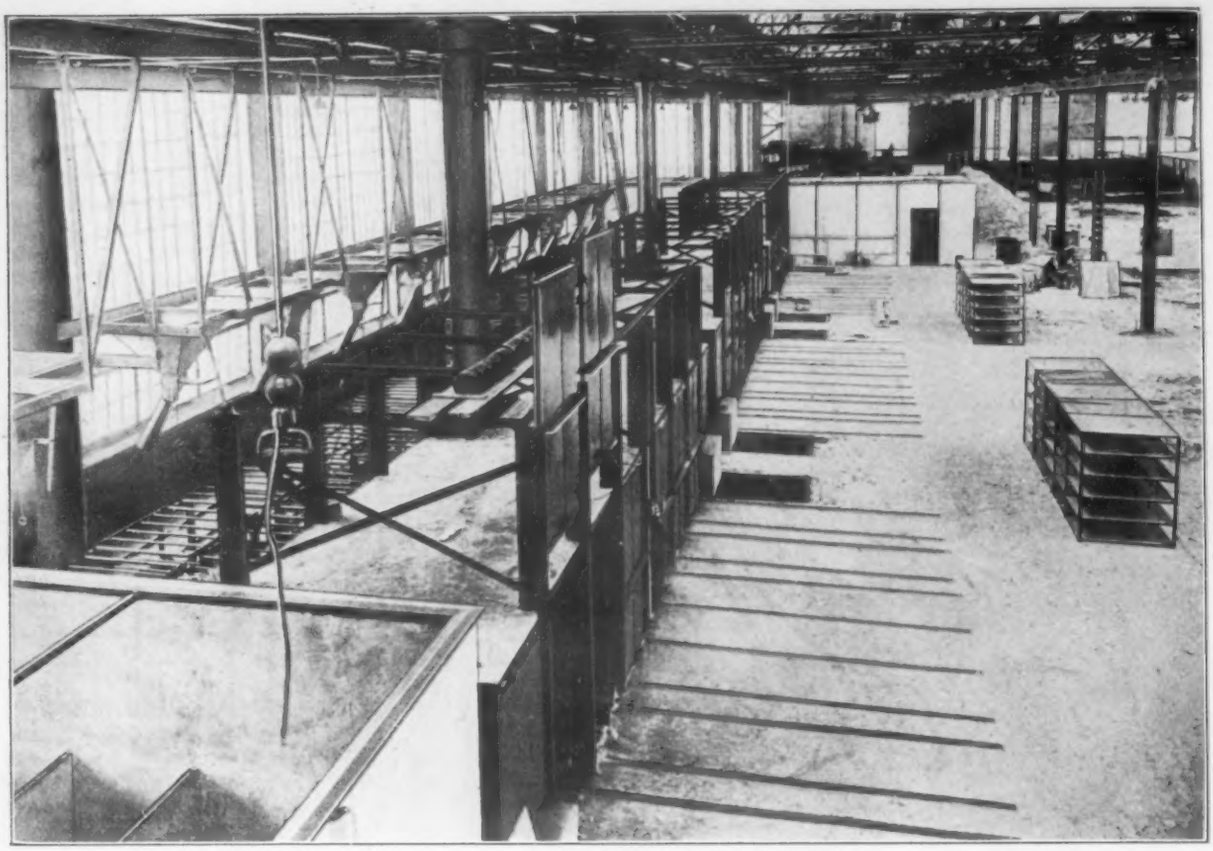


Fig. 8—Core Ovens for Women Workers, and Beyond the Women's Rest Room, Looking From the Cupola Charging Floor

nals corresponding to each core bench. By means of a push button at each bench the operator can indicate his or her need of sand.

A storage room for non-ferrous metals, 60 x 20 ft., is provided along the north wall of the west end and so located that metals can be unloaded from the cars directly into the room, weighed, stored and then conveyed to the crucible furnaces by the monorail system. Coke chutes are also located on this wall so that coke for the crucible furnaces and the core ovens may be delivered from the outside crane to the monorail system and thence distributed as required.

In the northeast corner of the building, occupying the triangle formed by the railroad track, are located the ovens for rough japanning crank cases, the sand blast room and pickling tanks. The triangle between the center line of the building and the track is occupied by the finished cleaning room. Immediately west of this cleaning room and occupying the width of one bay is the women's toilet, wash and rest room, 20 x 50 ft.

An office for the foreman, timekeepers and clerical force, 18 x 26 ft., is located in the southeast corner. Immediately adjacent thereto and extending along the southerly wall is the men's washroom, 70 ft. long by 14 ft. wide, the workmen's entrance being located at one end of this washroom, at which point are to be erected the time clocks. Between these rooms and the center line of the building is a pattern storage room, 38 x 60 ft., to which access is had from both the foreman's office and the body of the foundry. Here patterns for orders in the foundry are temporarily held pending use.

Extending along the entire north side of the foundry on the outside is a crane runway having a 60-ft. span and equipped with a 5-ton full electrically operated Northern crane. This crane is equipped with a magnet for handling pig iron and an independently motor-operated bucket for handling sand and coke. The storage space beneath this crane is used for flasks, coke and sand, there being provided 22 concrete sand bins, each 10 x 12 ft. x 9 ft. deep, with removable hatch covers.

The Advance in American Shipbuilding

(*Continued from page* 35)

at the same time. It can then regard and handle its work as manufacturing with all the resultant economies.

In the United States, however, a yard may have a dozen vessels under way, each of a different class and no two pieces alike for any of the vessels. It will be recognized at once that yards working under such conditions are at a serious disadvantage when competing with yards which have standardized and specialized their product.

The remedy for this state of affairs does not lie with the shipbuilder. With the volume of business that can be counted on as permanent, yards cannot afford to specialize but must take whatever is offered them. Until the shipping laws are changed, American ship owners will not build their ships under the American flag for foreign trade. When the laws are changed so that it will be profitable to operate American ships in open competition with foreign ships, the volume of business that will come to the American yards will be sufficiently great to permit them to specialize and thus meet the foreign yards on more nearly even terms.

Foreign Labor and Wages

As to the question of lower wages abroad, it is not so serious as is commonly believed. The writer had the privilege of visiting two of the largest yards in Germany shortly before the war. His impression of the equipment, arrangement and methods in those yards was distinctly unfavorable. Certainly they did not compare with the American

yards as now constituted. The highly developed use of mechanical aids in the American yards should operate at least to balance whatever difference there is in wages. The American workman, before the war, man for man may have been no more efficient than his British or German cousin, although this is open to argument. There seemed, however, to be more men placed at a given job in the German yards than would be the case in this country. Here again the wage cost tends to equalize itself.

Neither here nor abroad is labor handled as efficiently as it might be. If steps be taken to improve the labor efficiency in American shipyards to the point that has been reached in other industries, the advantage of labor cost per unit of product should be all on this side of the water. This statement is based on the conditions that existed in Europe before the war. If, as a result of the war, the efficiency of labor abroad has improved, the advantage will not be so marked and may perhaps disappear altogether. It is, therefore, all the more important for the American shipbuilder to look sharply into this phase of his problem. For the solution of the other phase—specialization and standardization abroad—we can only look to Congress.

The New Status of American Shipbuilding

(*Continued from page* 30)

gance in the opinion of many Government officials.

It is hardly to be assumed that the shipyards will regard it as a necessary act of patriotism to reject contracts from their regular commercial customers in order that they may make place for $50,000,000 worth of government cargo ships to be operated in cut-throat competition with the vessels owned by these same long-time customers. Of course, at the expiration of five years from the conclusion of the present European war the government is required to withdraw as a stockholder from all corporations organized by the shipping board to operate merchant vessels and the corporations will then be dissolved, the vessels being sold or chartered to private parties.

The granting of rebates, the use of so-called "fighting" ships, retaliation against shippers for their patronage of competing lines, the making of discriminatory contracts based on volume of freight offered, the giving of undue preferences to particular persons and localities, discrimination in the placing of insurance, the improper collection and dissemination of information to the disadvantage of shippers or competing lines of carriers, and the maintenance of secret tariffs were among the irregularities found to be practised not only in our ocean-going and coastwise trade but also upon the Great Lakes. By the terms of 17 of the 36 sections of the shipping act all these irregularities are specifically forbidden and the shipping board is clothed with authority to investigate all complaints that may be made by rival vessel owners or shippers. Authority is also conferred upon the United States courts to enforce, suspend, or set aside any orders of the board issued for the purpose of carrying out the provisions of the new law.

Owing to the delay on the part of the President in appointing the shipping board, water carriers have had ample opportunity since the passage of the law to conform their practices thereto and it is believed that very little friction will follow the initial enforcement of the new act. As in the case of the interstate commerce law, it may be assumed that important questions will arise concerning the meaning of various provisions of the act and as to the constitutional powers of the shipping board and these issues, no doubt, will require to be ruled upon by the United States Supreme Court. In the main, however, the statute is expected to operate smoothly and not only to render general water transportation practices uniform but to stabilize freight rates to a marked extent.

Russia the Most Promising After-the-War Market for American Products

(*Continued from page* 40)

whenever the opportunity came, some enterprises which presented chances of good profit. Such enterprises were many and of varied character; mines to be opened in ground containing coal, iron ore or other minerals; new manufactories to be built in some suitable territory in order to produce goods in great demand at the lowest prices; existing concerns to be purchased which were compelled to discontinue working on account of bad management or from lack of capital, and so forth.

The Society for the Study of Russian Enterprises, after having received from its members a brief report concerning a proposed undertaking, began a thorough investigation, sending trusted specialists to the district in order to examine very carefully, from the bottom up, all the questions and possibilities about it. If the proposition in all its aspects promised success, a company was immediately formed for its development.

As a member of the above company I saw in its brief existence preceding the war some enterprises established and exploited with great success. The shares of the Society for the Study of Russian Enterprises after two years were worth 3,000 francs, their par value being 1,000 francs.

Time Ripe for American Investigation

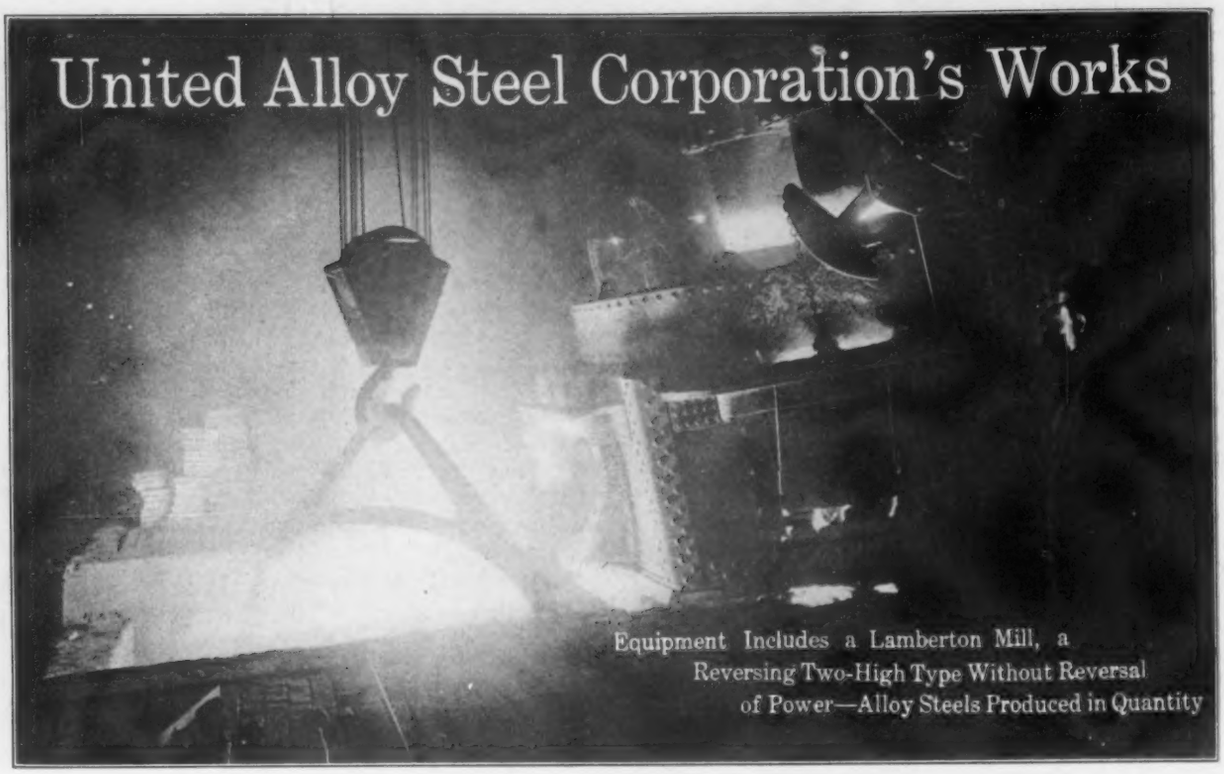
I think it would be possible and very profitable to establish a similar company in this country with representatives in Russia who would be able to examine, in a preliminary way, the great number of possibilities that great nation will present when the war is over.

In one word, America can take the place of all those European nations which, considering Russia a territory full of promise and opportunity, in the years immediately preceding the war sent their representatives there and invested large amounts in innumerable enterprises. It is evident that those nations, weakened by the fearful struggle, will employ for a long time all their resources, capital and energy exclusively in the re-establishment and development of their own commerce and industry.

At the present time there is a general tendency to learn Spanish; but I think it would be very wise to encourage also the study of the Russian language, because American youth in the near future will find many opportunities to hold advantageous positions, when a large volume of American goods and money will necessarily be directed toward the immense Russian empire.

England lately introduced the study of the Russian language in the majority of her schools, and the government is contributing large sums in public and private institutions for this purpose. Many students are on the way to be sent for a sojourn in Russia in order to give them the opportunity to acquaint themselves with the business of that country. It is proposed also to give special courses of lectures in British universities on Russian jurisprudence, commercial practices and methods of trade. If Great Britain does this, it is evident that she has understood perfectly what Russia can give her in the future. Why should not the United States adopt the same system and on a larger scale?

United Alloy Steel Corporation's Works



Equipment Includes a Lamberton Mill, a Reversing Two-High Type Without Reversal of Power—Alloy Steels Produced in Quantity

NOTABLE extensions were made in 1916 to the plant of the United Alloy Steel Corporation, Canton, Ohio, formerly the United Steel Company. This plant is of special interest in that it is designed for the production of alloy steels on a very large scale and includes varied types of equipment for melting, rolling and heat-treating. Since the United plant was established in 1904, with two 35-ton furnaces and a small blooming mill the demand for alloy steels has grown rapidly from year to year, due largely to its tremendous consumption by the automobile trade, and numerous extensions have been made to the United works until the plant, with the completion in the spring of four open-hearth furnaces now under way, will have an ingot capacity of 60,000 tons per month.

Its building program of 1916 includes the new steel plant known as plant B, consisting of ten open-hearth furnaces, six of which were placed in operation last summer, a 35-in. blooming mill, started Dec. 5, and an 18-in. sheet bar and billet mill, put into operation late in December. Plant B adjoins that of the old works, all the mill buildings of both plants being located along the line of the Pennsylvania railroad. Additions to the old plant include a 15-ton Heroult electric furnace, a billet and bar mill of the Lamberton type and an 8-in. continuous bar mill. Also there was blown in on Nov. 22 the blast furnace of an allied company the United Furnace Company, controlled by the United Alloy Steel and Pickands, Mather & Co. interests. This occupies an adjoining site and will furnish molten metal for the United open-hearth furnaces. This furnace has a daily capacity of about 500 tons. In connection with it have been built 47 Koppers by-product coke ovens with a daily capacity of about 600 tons.

The United plants, excluding the four open-hearth furnaces not yet completed, include three 50-ton, two 60-ton and nine 75-ton open-hearth furnaces; one 35-ton tilting open-hearth furnace; one 15-ton and one 6-ton Heroult electric furnace; one 35-in. blooming mill; one 34-in. universal reversing slab and plate mill; one 26-in. Lamberton billet and bar mill; one 18-in. Morgan sheet bar and billet mill; one 8-in. continuous bar mill; one 20-in. five-stand bar mill; one 10-in. five-stand bar mill with 14-in. Belgian roughing rolls; one 9-in. five-stand bar mill with 14-in. Belgian roughing mills; a modern cold drawing and heat-treating plant and a 500-ton Davy press for forgings. Extensions under way and not referred to above include a new heat-treating plant that will be completed early in the year and a machine shop 100 x 300 ft. in connection with plant B. This will be equipped with the most modern machinery for steel plant work.

The new plant is entirely electrically operated with the exception of the flying shear connected with the sheet bar mill and two pumps that are steam driven. The old plant is all electrically operated with the exception of one steam driven mill. Electricity is supplied by the Canton Electric Company.

The new open-hearth plant contains six 75-ton furnaces, space being provided for four additional furnaces which are now being erected. The open-hearth building is 940 ft. long and its total width is 190 ft. The charging floor is 10 ft. above the mill floor and yard level. This floor is 70 ft. wide and has a 16-ft. leanto for the valve cellars. Adjoining the open-hearth building on the charging side is a charging trestle on a level with the charging floor. On this trestle are two standard gage tracks with a cross over at every second furnace so that any two furnaces can be charged at one time. Under the trestle are 47 steel bins, for flux, manganese, etc. The inner trestle track is used only for charging cars which can be run on to the trestle track from either end. Alongside the trestle is a depressed track 4 ft. below the mill floor. Material from the bins is shoveled into the charging boxes on this track.

The furnaces extend 10 ft. below the mill floor and yard level and have waterproof bottoms and in addition are set in false concrete bottoms to eliminate danger of dampness. There is a pitch of 9 in. in 70 ft. from the false bottoms leading to the valve cellar level where a steam syphon is provided to pump out water should any seep through into the false bottoms. The open-hearth furnaces

are of standard type and are equipped with Schild gas valves, Knox water-cooled doors and electric door hoists. Each door is operated by a 5-hp. Westinghouse motor through a worm-gear device. The furnaces were built by the S. R. Smythe Company, Pittsburgh. The door hoists were furnished by the Youngstown Engineering Company.

The molten metal for the open-hearth furnaces, supplied by the adjoining blast furnace of the United Furnace Company, is carried in 60-ton hot-metal ladle cars and dumped into a 300-ton standard Riter-Conley built mixer at the north end of the open-hearth building. The mixer is lifted and tilted by two Westinghouse motors through a worm drive. Forty-ton ladles carry from mixer to the open-hearth furnaces and a 60-ton Alliance ladle crane is used, with 25-ton auxiliary.

Two 10-ton machines are used for charging the furnaces, one a Morgan high-floor type and the other a Wellman-Seaver-Morgan low-floor type, operating on a 16-ft. track. The pouring side of the open-hearth plant is 65 ft. wide and is served by two 125-ton four-girder Alliance cranes and one Morgan crane of the same capacity. The metal is run into 80-ton steel pouring ladles.

Convenient to the open-hearth plant on the opposite side of the gas producer building is a stock-yard building. This is 600 ft. long and 96 ft. wide and is served by two 10-ton Alliance cranes equipped with Electric Controller magnets. Three tracks extend through this building, two for handling scrap and one for charging buggies. Part of the stock is handled directly from the cars to the charging boxes and part is taken to the stock pile. Standard charging boxes are used, four on a steel charging car. Additional storage room is provided outside at each end of the stock room where the material is handled with locomotive cranes. The skull breaker shed is 66 x 300 ft. in dimension and is provided with a 15-ton Alliance crane and two drum hoists for handling 8-ton balls. Molds are stored in a 60 x 300 ft. mold shed.

Gas for the open-hearth furnaces is furnished by 20 Morgan mechanical producers, located in a steel building, 25 x 560 ft. The producers are grouped into batteries of four, each group supplying two furnaces; as three producers suffice for two furnaces, there is always a spare producer in each battery. The gas flues from producers to furnaces are overhead and of steel lined with brick. A 40-ton steel bunker is supported over each producer, and in addition there is sufficient coal in storage for 10 days' requirements. The producer house is supplied with two coal crushers; two ash handling plants; and two overhead cranes equipped with Brocius clam-shell buckets for handling coal and ashes. Ashes are stored in pits of 4 or 5 carloads capacity and are emptied by the clam-shell buckets into a hopper which discharges into cars alongside.

Between the producers are two batteries of waste-heat boilers, each battery consisting of two 500-hp. Babcock & Wilcox boilers, and space will allow for eight additional batteries of boilers, the producers being arranged for a boiler installation between every two producers. The steam generated in these boilers is used in the blooming mill for operating the flying shears, for blowing the producers and for various other uses.

The soaking pits are located in a building 425 ft. long and 75 ft. wide. There are four soaking pits each with four 7 x 8-in. holes. The covers of the pits are electrically operated through rack and pinion. The operating mechanism is located in a 20-ft. leanto. The soaking pits are arranged to be fired with natural gas or with by-product coke gas. The latter is now used, being brought from the by-product plant of the United Furnace Company in a 20-in. cast-iron main at 6 lb. pressure and reduced to 8 oz. pressure at the pit furnaces.

The 8-In. Continuous Mill. Roughing mills are in front of the furnace, and in the center of the picture are the finishing rolls located in a staggered position. In the foreground, at the left, are the two coilers. The drive for the last finishing stand is at the left

The Lamberton Mill from Its Approach Side, Showing Also Driving Shafts

Adjoining the soaking pits is a bay in which ingots are stripped. A 15-ton crane is provided in the soaking pit building for auxiliary work.

The blooming mill and sheet bar mill occupy a building 96 x 800 ft., a wide structure being provided to make room for both mills. The blooming mill is a two-high 35-in. reversing mill built by Mackintosh, Hemphill & Co. The mill is built unusually heavy to roll alloy steel, being about as heavy in construction as is usual for a 40-in. mill. The mill is equipped throughout with universal couplings, and has cut helical gears on the main pinions; the gears are all inclosed and run in oil. The mill tables have inclosed cut gears running in oil and ring bearings. The mill has front and rear Kennedy manipulators.

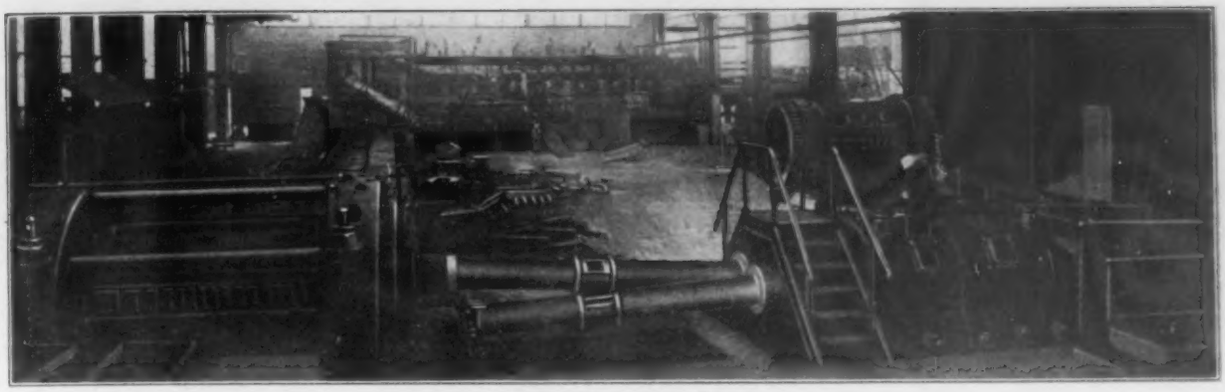
The blooming mill is operated by a 15,000-hp. direct-current reversing Westinghouse motor. A current of about 1500 volts for driving the main mill motor is supplied by a flywheel generator set, consisting of two generators and one motor, the speed of the generator set being controlled by a liquid slip regulator, which allows the flywheel to furnish the energy for the peaks coming on the generator. The main mill motor will run in speed up to 120 r.p.m. The generating set is composed of two 600-volt, 352-r.p.m. generators and a 2500-hp. 2200-volt 60-phase 3-cycle induction motor.

The blooming mill approach table is 90 ft. long and the mill table is 50 ft. long on both the approach and delivery side. From the delivery table the bloom is carried on a run-out table 360 ft. long, providing a straight run-out to one of the shears. At the side of the run-out are two transfers, each 160 ft. long. The first of the transfers is 60 ft. and the second 27 ft. wide. Both transfers are divided into two sections, each operated by a separate motor. The former is a quick acting rope driven transfer used for transferring slabs to the sheet bar mill on the opposite side of the building from the blooming mill. The second transfer is a chain transfer that takes the steel from the run-out table to the second shear.

The capacity of one shear is 6 x 30 in. sections and the other 8 x 36 in. sections. They are motor driven and are equipped with back shear tables and gages for cutting off up to 30 ft. lengths, electrically operated kick-offs, bundling cradles, etc. The run-out tables and shears were furnished by the United Engineering & Foundry Company. All mill tables are operated under the Westinghouse type of magnetic control.

The sheet bar and billet mill is a standard Morgan 18-in. mill driven by a 4200-hp. Westinghouse synchronous motor. It consists of six two-high stands of 18-in. rolls, arranged in tandem. It is the intention to install later a roughing mill of four stands of 21-in. rolls, space being provided. On the delivery side is an Edwards steam flying shear. There is an auxiliary sheet bar yard adjoining the end of the delivery table to which sheet bars are

Blooming Mill from Approach Side, and at the Left the 18-In. Sheet Bar and Billet Mill



Lamberton Mill with Heating Furnace in the Background. Cage with new set of rolls and guides at the right ready to be substituted in the mill housing

transferred by rope transfer. This yard contains a 30 x 80 ft. Morgan hot bed and shipping yard scales and is served by a 120-ft. 15-ton Alliance crane with a 240 ft. runway. The blooming mill and sheet bar mill are served by two Alliance cranes, one of 25 tons capacity with a 15-ton auxiliary and the other of 15 tons capacity. Adjoining the mill building on the blooming mill side is a motor house 50 x 200 ft. and on the sheet bar mill side a motor house 36 x 200 ft., in which are housed the motors for driving the mills. The former is equipped with a 50-ton crane and the latter with a 30-ton crane.

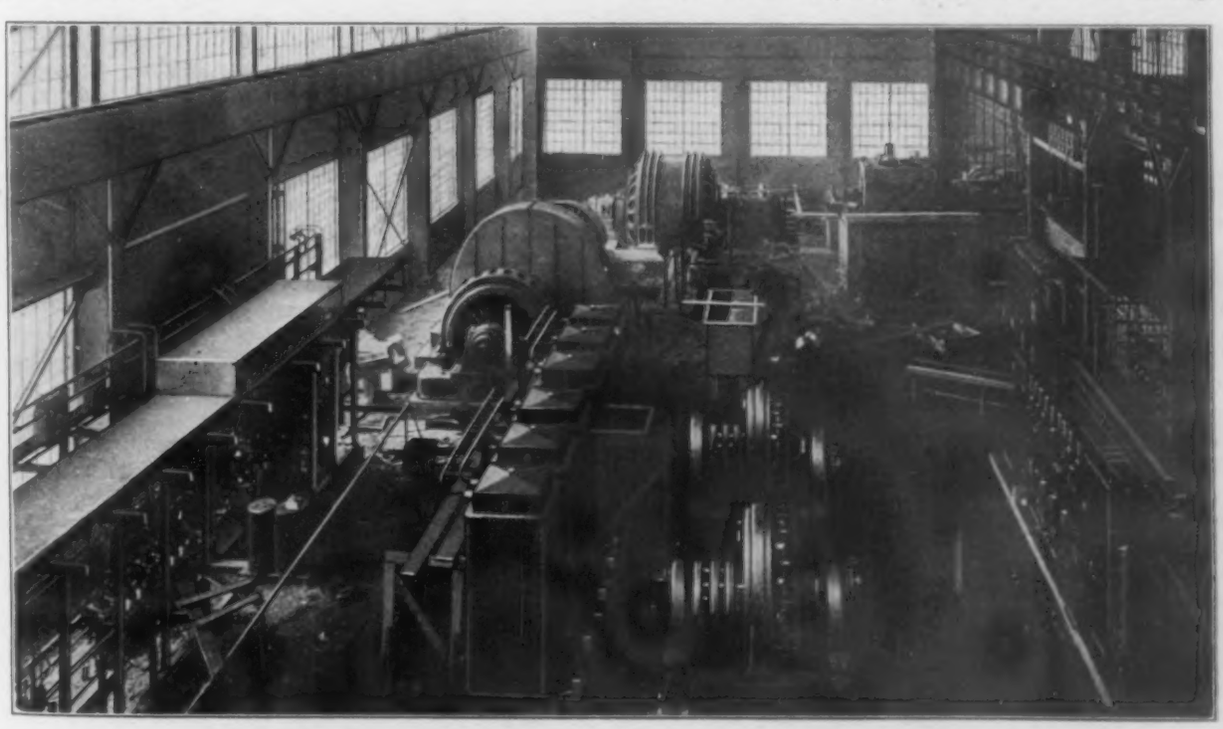
All mill buildings have factory ribbed glass in Fenestra sash. Steel sash and ribbed glass partitions separate the motor houses from the blooming mill floor.

Ingots are rolled on the blooming mill into 8 x 3 in. slabs for sheet bars, and the sheet bar and billet mill will roll sheet bars from 7½ to 40 lb. per foot in lengths up to 30 ft. Billets 4 x 4 in. and larger are rolled on the blooming mill. The ingot is usually given 19 to 21 passes to reduce it to a 4 x 4 in. billet. For smaller sizes the ingot is rolled down to 5 x 5 in. sections on blooming mill and reduced to smaller sized billets on the billet mill. On the blooming and billet mill an ingot is reduced to a 1¼ x 1¼ in. billet without reheating. The capacity of the two mills is from 1¼ in. billets to a 13-in. square bloom and in flat sections from 7½ lb. per ft. sheet bar up to a 33 x 8 in. slab.

The Morgan 8-in. continuous bar mill occupies a T-shaped building located between the old plant and plant B. The main building is 90 x 680 ft. and at the south end is a stock transept 90 x 200 ft. in plan. The stock house is served by a 10-ton and the mill building by two 10-ton Morgan cranes. Billets have been supplied for this mill from the Lamberton mill, but are now being supplied from the new billet mill in plant B.

Billets from the stock house are deposited on a Morgan feeding table which feeds them into a Morgan standard billet heating furnace. This furnace has a 15 x 32 ft. heating chamber, inside dimensions. It is fired with coke-oven gas. The billets reduced in this mill range mostly in 1¾ x 1¾ in. to 2½ x 2½ in. sections and are received in 30 ft. lengths.

The 8-in. mill has six stands of 12-in. continuous roughing rolls and two stands of 10-in. roughing rolls. The roughing stands are equipped with a measuring shear at the front and a steam flying shear between the 12 and 10 in. stands for clipping the front end of the bar after it passes through the first six stands. The finishing mill consists of one train of two stands of 10-in. rolls, one train of two stands of 8-in. rolls, and one train of four stands of 7½-in. rolls. Each four stands is a separate unit and is driven by a separate motor. The roughing train is driven by a 1250-hp. direct-current motor and each of the others by a 400-hp. variable speed motor. The roughing stands are driven through



Mill Motor and Flywheel Generator Set in Blooming Mill Motor House

bevel gears; the first two finishing sets are driven directly from the motor and the last four finishing sets are belt driven.

The ordinary Morgan mill consists of 12 stands of rolls. In this mill the four additional stands make the mill flexible and permit, it is explained, the rolling of a good tonnage of high-grade steel. The speed ranges of the finishing mills are as follows: First, or roughing stand, 300 to 400 r.p.m.; second stands or first finishing stands, 325 to 450 r.p.m.; third stands, 375 to 500 r.p.m.; fourth stands, 375 to 500 r.p.m. The sizes manufactured on the mill are rounds up to 1 5/32 in. and spring stock 2 in. wide and up to ⅜ in. in thickness. In rolling down to ⅜ in. bars, the bar is passed through only the roughing and two finishing trains, the last pass being through the No. 12 mill. If the bar is to be reduced under ⅜ in. it passes through two or all four stands of the 7½-in. rolls.

From the twelfth stand the completed bar goes to a Morgan single-escapement cooling bed 250 ft. long. The scales are under the bundling rack and the bars are weighed as they are sheared. The shears cut the stock into multiple lengths. Two spring shears are also provided for cutting spring stock into spring lengths. For sizes smaller than are finished on the No. 12 mill, the bar, instead of running from the mill to the hot bed, is passed through a pipe to mills 13 to 16 of the 7½-in. stands. In these stands sizes down to ⅛ x ¼ in. flats and No. 5 wire or about 3/16-in. rounds are made.

There are two Morgan automatic coiling reels, used alternately, as usual. The wire is coiled in 100 to 300 lb. bundles and is discharged directly into a Morgan annealing conveyor 200 ft. long, at the end of which the bundles are elevated and discharged to trucks. The coilers are belt driven from the mill motor shaft and their speed is controlled by the speed of the mill. Reels can be made on the coilers from 34 in. to 16 in. inside diameter. It is stated that mechanical coilers of this type have not previously been made to coil reels under 22 in. inside diameter, although coils that small in diameter are made on some hand fed reels.

If it is desired to coil bars in larger sizes from the No. 12 mill the pipe that directs the bar from the mill to the coiler is swung around to the No. 12 mill and the bar passes through the pipe to the coiler instead of to the hot bed. Merchant bar stock is coiled in sizes up to ¾ in. rounds and 5/16 x ⅛ in. flats. When a bar is coiled from the No. 12 mill the coilers are driven from the shaft of the motor that drives the third train of rolls, of which this mill is a part, and in this case the speed of the coilers is regulated by the speed of the mill the same as when the motor is driven from the motor shaft of the last stand. The drive from the No. 12 mill motor to the coiler is through a line shaft in a pit under the mill floor. The coilers are controlled from a cage near the last mill stand. The 8-in. mill is used for the manufacture of alloy steel for various uses, among the most prominent being stock for roller bearings, springs, axles and shafts in vanadium, nickel, manganese chrome and other alloys. A depressed track runs into the mill building at the lower end a distance of 400 ft. and provides a shipping platform.

The new Lamberton mill is a 26-in. billet and bar mill. Only two mills of this type have been built, the original one being in operation in Great Britain and described at length in THE IRON AGE of May 15, 1913. This mill, however, it is understood, has many refinements not contained in the mill of this type built in England. The Lamberton mill building is 416 ft. long and 75 ft. wide and adjoins the blooming mill building of plant A. Blooms are being supplied from the 34-in. universal mill adjoining, but will be furnished shortly by the new blooming mill of plant B. Arrangement is provided for taking blooms from the adjoining blooming mill plant and reducing them on the Lamberton mill without reheating. This, however, has not been done so far, as the Lamberton mill has been running entirely on alloy steel and the blooms are chipped before rerolling.

The blooms are passed through a standard continuous end discharge furnace now fired with coke gas, but also arranged for the use of either producer or natural gas. The heating chamber of the furnace is 42 ft. long and 13 ft. wide. The furnace is equipped with a double-headed electric pusher and has four skid pipes so that it can be charged with one row of 6-ft. or two rows of 12-ft. blooms. In usual practice the blooms come to the Lamberton mill in 6 x 8 in. or 7 x 9 in. sections. A bloom as short as 54 in. can be reduced on this mill, but an 11-ft. bloom is usually used, as this works out to the best advantage on the hot bed when rolling a 2½ x 2½ in. billet.

The mill table has a manipulator on each side for handling the piece which is received in a slot in the manipulator, and the operator, standing on the foot plates between the rollers, turns the piece with tongs. The first 7 rollers have grooves the same size as the corresponding mill passes and the operator turns the piece over on these grooves without much difficulty.

The Lamberton mill is a two-high mill with rolls 26 in. in diameter by 96 in. face. It is driven by a 1500-hp. Westinghouse alternating-current motor at a constant speed of 65 r.p.m. The motor is equipped with a slip regulator. The drive is through helical cut gear and pinion with a reduction of 5 to 1. A 30-ft. flywheel is provided in the driving shaft between the main drive and pinions. There are two helical cut pinions set horizontal instead of vertical. The power is delivered to the mill rolls through two shafts constructed with universal joints. These shafts are counter-balanced at this center with a dash-pot counter-balance operated with compressed air. The mill rolls are set in a circular housing mounted on roller bearings. After the piece passes through the mill in one direction the mill is revolved 180 deg. in its housing by means of a rack and pinion operated by a hydraulic cylinder and the top roll becomes the bottom, the ends of the shafts, of course, changing their position with the half revolution of the rolls. After each pass the relative position of the two rolls is reversed and the piece being rolled may be passed backward and forward while the rolls themselves continue revolving in the same direction.

Entering guides and delivery guides to the mill are fastened to the mill housing and roll over with the mill. In changing rolls the cage containing the two rolls is lifted from the housing and a spare cage with a new set of rolls and guides already set up is substituted, 30 min. sufficing to make the change.

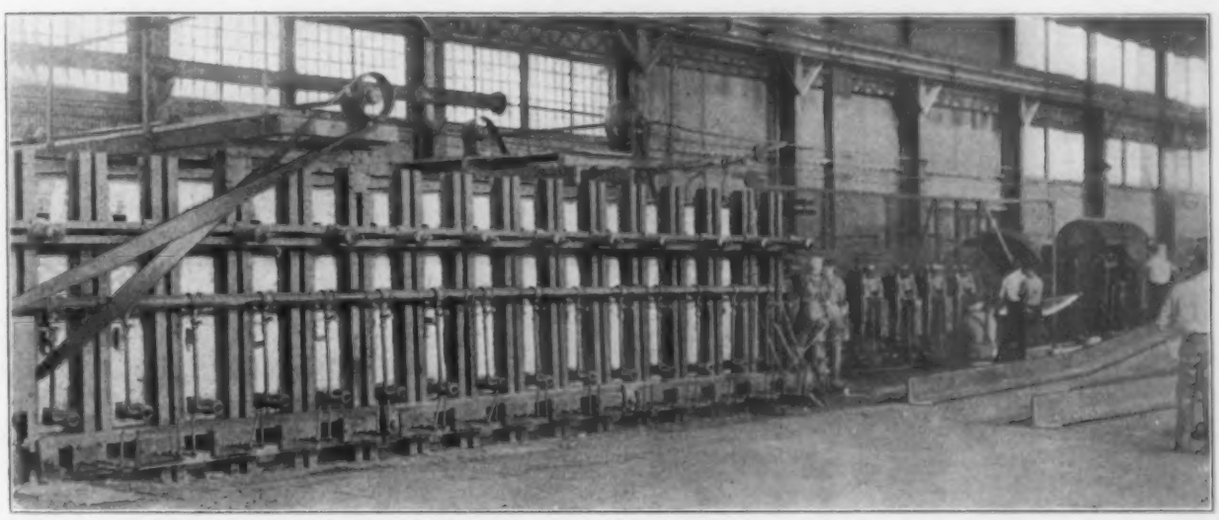
From the mill table there is a run-out table 125 ft. long and the rolled billet or bar passes from this to a transfer 125 ft. long and 30 ft. wide. On the opposite side of the transfer is a shear with its roller tables. The shear cuts the billets cold and has a capacity for shearing a 5 x 5 in. section, and on the run-out side there is also a 42-in. hot saw.

The mill has a capacity for rolling 1¼ x 1¼ in. to 5 x 5 in. billets and 1½ to 5 in. round bars and also a wide range of flats. It has been used for making both billets and bars, but with the completion of the new billet mill it is the intention to

use it almost exclusively for rolling round bars, mostly in 5 in. sizes. Thirteen passes through the mill are required for reducing a 6 x 8 in. bloom to a 2½-in. square billet. The capacity of the mill is 8000 to 12,000 tons of billets or bars per month.

The Lamberton type of mill was selected in preference to a two-high blooming mill with a reversing motor or a three-high mill with tilting tables. The choice was made to avoid the use of a reversing motor required for an ordinary two-high mill and to employ stationary tables instead of tilting tables as required for a three-high mill. The Lamberton mill, mill drive, mill tables, bloom and billet shears and hot saw were built by Mackintosh, Hemphill & Co. The mill is served by a 40-ton and a 20-ton crane.

The Heroult electric furnaces are located in an extension to the old open-hearth plant. The new 15-ton furnace, which takes three-phase current at 60 cycles, is charged with standard charging boxes handled by an overhead 7½-ton Morgan traveling crane. The hot metal from the 35-ton tilting furnace in this building is used in part for the charge. The molten metal is charged with a 30-ton ladle crane, which is also used for pouring.



Side View of the Reheating Furnace and Roughing Mills in 8-In. Mill

The steel is cast into ingots of 500 to 8500 lb. Some of the small ingot molds are of the split type and are rolled directly on the bar mill.

The new heat treating plant that will be placed in operation shortly is to be equipped with two automatic continuous annealing and tempering furnaces, two car-type annealing and heat-treating furnaces and four hand-operated annealing furnaces, all for heat treating bars up to 30 ft. lengths, and two floor type for heat treating steel in coils.

The United Alloy Steel Corporation is under the management of its president, H. R. Jones, who was manager and vice-president under the former organization of the United Steel Company. E. D. Rogers is vice-president and general manager of sales, and E. L. Hang is secretary. The output is nearly all in alloy steels. These include chrome vanadium, chrome, nickel, chrome nickel, silico, manganese, chrome silico manganese, magnet, tungsten and various alloy steels of special analysis.

The Ladish Drop Forge Company is the new name adopted for the Ladish-Obenberger Company, Cudahy, Wis. Increased equipment for manufacturing drop forgings places the plant in a position to accept orders for forgings of any size or quantity, and it is prepared to make forgings from any grade of steel specified.

MODERN WORKS BUILDINGS

For Offices and Laboratories of the Youngstown Sheet & Tube Company

Coincident with the remarkable development of the iron and steel industries in the past decade has been the growth of appreciation shown by corporations for the men upon whose earnestness, enthusiasm and efforts the industry depends. In the same manner that employing corporations have come to recognize in a broader and more liberal way their duties to the men who work in the mills and at the furnaces, providing for them conveniences and comforts formerly unknown as well as spending large sums for the promotion of their health and safety, these corporations are now paying more attention to the comforts and conveniences of men who perform managerial and clerical duties.

The practice of housing these forces in unattractive buildings, illy furnished, located in the midst of the dirt and noise to be expected with a large steel plant, and frequently at points chosen rather because of their uselessness for other purposes, than because of their availability for offices, is being supplanted by efforts to group them under more favorable conditions.

A striking example of this tendency is seen in the general works office and laboratory buildings recently completed by the Youngstown Sheet & Tube Company at Youngstown, Ohio. In these buildings are located all the executive and clerical forces of the operating departments, as well as all of the laboratories, except that connected with the by-product coke and benzol recovery plants, which are provided for in buildings located within those units. For the superintendents, commodious offices had already been erected in locations convenient to the departments over which they have charge.

The new office building is interesting as typifying the highest development along that line, and being in this respect probably unexcelled. The structure is located near the main south gate of the works, on a slight elevation overlooking them across the Mahoning River, which is spanned at this point by a wagon and foot bridge. It is of fireproof construction, built of gray brick and steel. The building is four stories in height, and fronts 158 ft. on a street leading from the entrance to the works. One wing fronts on Poland Avenue 141 ft., and another wing on the opposite side is 90 ft. deep. The building has a total floor space of 57,800 sq. ft.

It was erected by the Stone & Webster Engineering Corporation, Boston. The architects were Graham, Burnham & Co., Chicago.

Special attention has been paid to the fenestration and ventilation, with the result that these are features most prominent in the structure. All corridors and stairways are wainscoted and floored with white Tennessee marble. The building is equipped with two electric elevators. It is lighted with electricity, direct current for both it and the laboratory across the street being furnished by a motor-generator set operated by high-tension alternating current carried from the works. Steam heat for both office and laboratory is secured from the same source. Steam lines from the blast furnace power plant are carried across the river to a tunnel which extends between the two buildings, and from that point extend to both.

In the works office building an effort has been made to place each department in the location best suited to it because of room available, or for other reasons. The offices of the second vice-president and general superintendent, with their secretaries and assistants, occupy the north wing of the main floor, with a library across the corridor in the same wing. Half the front of this floor is occupied by offices more or less connected with these, and convenient in the same locality, and by a reception room.

Southward from the main entrance and around the south wing extend the offices of paymaster, pay and time departments and the relief association, while across the front on the inner side of the corridor are located mailing room, addressograph department, vaults, toilets for men and women, elevators, rooms for stenographers and various smaller offices and departments.

On the third floor the north wing is occupied entirely by the cost department, with a large force of clerks and stenographers, and a number of offices directly connected with this department. In front is found the raw materials department, a women's retiring room, offices for inspectors engaged on regular work and also for a large number of inspectors engaged on special work and employed by purchasers of the same. The south wing provides accommodation for the purchasing department, with its force of clerks and stenographers, the safety department, and a large assembly room. As on the main floor, a corridor extends around the building and on the inside of this are located numerous offices, a janitor's store room, battery room, toilets and vaults for records in constant use. The telephone exchange is on this floor.

The fourth floor is occupied in large part by the engineering departments, civil and mechanical, with the clerks, draftsmen and stenographers attached to them. Room is provided on this floor also for a number of inspectors. In the south wing is located the steam engineering department, while the photographic department occupies the interior side of this wing. The inner side of the front is occupied on this floor by toilets, blueprint room, vaults and similar accessories.

The basement floor is one of the most interesting sections of the building. In the main wing on this floor is located the restaurant, one of the most complete in the country. It consists of a kitchen and dining room finished in white tile, main dining room, officers' dining room, superintendents' dining room, ladies' dining room, cold storage room, refrigerating plant, laundry and pumping plant, by which water is drawn from deep wells, cooled, filtered and circulated to all parts of the building for drinking purposes. The restaurant is intended for the benefit of the clerical and similar forces employed in the works and is operated on a cost basis, no attempt being made to secure a profit. Luncheon is served over three hours in the middle of the day and no other meals are provided. At the present time about 350 meals per day are being served at a charge of 25 cents each, these meals being about the same quality as those served in the ordinary restaurant for 50 cents. The restaurant is patronized by the superintendents, clerks and stenographers located in the works as well as by those employed in the office building. Before the erection of this building, a restaurant was maintained in the main works under rather unsatisfactory conditions, such a convenience being necessary on account of the plant's being located at some distance from Youngstown. The remainder of the basement is given over to the office supply department, storage vaults, lighting and cleaning machinery and similar purposes.

Office Building of Youngstown Sheet & Tube Company at Left and Laboratories at Right

An abundance of vault room has been provided in such location as to make its use convenient, and the arrangement of offices is such as to assure the minimum loss of time in communication between the various departments and their accessories. The furnishings in the executive offices and the rooms occupied by heads of departments are of mahogany, and where this is the case the interior trim and floors are finished accordingly. In the rooms occupied by clerks, stenographers, draftsmen, etc., the finish and furnishings are of oak, selected with special reference to utility, appearance and convenience. The service of messenger boys is largely dispensed with by the complete telephonic system of intercommunication with various offices, and all departments of the works.

The structure shown in the photograph in connection with the office building is the new laboratory, erected during the past year. This building was designed by C. F. Owsley, Youngstown, and erected by the Stone & Webster Engineering Cor-

poration. Architecturally and in detail it resembles and harmonizes with the office building, although much smaller in dimensions, having a frontage of 115 ft., and two wings each 88 ft. in depth. The total floor space available in this building is 7140 ft. The exterior is of gray brick and steel. The vestibules are wainscoted with marble, and, with the halls, have terrazzo floors. The stairways are of similar material. The floors in the offices are of hard wood and in the operating rooms asphalt.

Special provisions are made for lighting and ventilation, the latter being taken care of with full appreciation of the possibility of dangerous gases developing in the work to be carried on. Plumbing and other piping is largely of wood and lead and the chemical equipment of the laboratories is notable in respect to this equipment. The provisions include an abundant filtration plant, and over each aisle in the laboratories shower baths by which a chemist can quickly protect himself against accident from acids or other noxious fluids.

Both the office and laboratory buildings are surrounded by generous lawns terraced and maintained by concrete retaining walls. These will be beautified with flowers and shrubbery.

A hospital building is located on the opposite side of the plant at the main north gate, this side having been chosen because a large proportion of the employees reside in the village of East Youngstown. At this point the hospital will be accessible to the men and such members of their families as desire to make use of its facilities.

The Treatment of Export Inquiries

Leaves from the Book of Machinery Salesmanship — Painstaking with Vague Inquiries Has Its Reward

BY STERLING H. BUNNELL*

Imagination is a faculty which is sadly neglected in business, particularly in engineering matters. We give it occasionally a little exercise by trying to supply the omitted words in a telegram, or searching for the meaning between the lines of a letter. In export trade, when it takes days (and dollars) to get a question answered by cable and weeks by letter, a lively imagination is a treasure to its possessor. A good guess may save an exchange of letters that would take three months, and bring the business to a prompt completion.

In nine cases out of ten, an inquiry from a prospective purchaser lacks some of the details necessary for a complete answer. If it is a domestic inquiry, the reply is by personal call from an experienced salesman capable of analyzing the conditions and advising the purchaser what to buy. If the distance is so great that the visit seems too costly, a letter or printed form with many questions is sent to the inquirer to inform him what details must be determined. Most manufacturers are so accustomed to doing business on exact information that they give scant attention to any inquiry that is not presented in the form which they prefer. They reply to one question, in Yankee style, by asking other questions.

Blind Inquiries Worth Digging Into

Export inquiries are almost invariably incomplete, and they can rarely be made definite by correspondence without killing the business by delay. The difference of national standards and trade customs makes the inquirer's intent uncertain from the manufacturer's viewpoint. The request may be for a new device or article known only vaguely, by hearsay. The technical knowledge of the foreign purchaser is hardly ever as exact as might be wished by the man who attempts to get at his wants from his letter. But behind the insufficient words of the letter or cablegram there is undoubtedly a definite want, which the manufacturer's correspondent salesman must ascertain if he is to make use of the advantage of the direct inquiry. The man who has taken the trouble to write from another country to America has done so because he could not get at home the thing he wanted, and because he wanted it enough to be willing to wait for the exchange of letters, pay the freight, insurance and import duty, and perhaps go to the trouble of composing his communication in the foreign language of English, to accommodate the American who will not learn another tongue. An inquiry from such an eager purchaser is certainly worth special attention and a full reply.

With this idea clearly in view, the foreign letter can be made to tell a story much longer than is disclosed by a casual "once over." Does the letter indicate that an immediate sale is possible? If so, the answer should be a full description of all of the manufacturer's machines or other devices that may possibly fit the situation, with illustrations, shipping weights and dimensions, and prices at a seaport. The descriptions should cover the methods of use of the machines rather than the materials of construction, for the foreign purchaser is likely to know little of American practice in operating machinery, but to take for granted that the construction will be strong and durable. The description suitable for a reply to a foreign inquiry is generally just the opposite of that given in the American catalog.

Structural Details Secondary

As catalogs are often bulky and heavy to mail, the best form of reply is likely to be a typewritten special explanation and a catalog picture pasted to the sheet. The writer of this article has frequently found it impossible to make a selection from the machines shown in an elaborate catalog, because, while selected cast iron, special alloy steel, ground surfaces and all sorts of constructional details were enumerated, there was not a word about the comparative usefulness of the several types shown and the service to which each was specially adapted. The foreign buyer will probably have only one catalog before him when making his selection, and comparisons of constructional details of competitive manufacturers will not interest him to the exclusion of the knowledge of what the machine will do and how it will operate.

A very full answer, running into several pages

*Chief engineer, R. Martens & Co., New York.

of non-technicalities, may bring an order for one or two of the items offered, without further delay for correspondence. To make this possible, the letter of quotation must give all the information necessary to enable the purchaser to compute the cost of the machine set up in his factory. The quotation should therefore state the price free alongside ship in a convenient United States seaport, and should mention the ocean freight tons of the shipment, the present freight rate and insurance. If this is the limit of the quotation, it is left for the purchaser to ascertain the import duty of his own country, the inland freight rate, and other expenses, and he may not be in position to get these figures easily. It is always the best plan to quote the prices c.i.f. seaport, in the country of destination, or the usual port of entry for that country if it be an inland state. The c.i.f. price includes the cost of goods, insurance against sea risks and freight by vessel to port of destination. It is therefore a delivered price, bringing the goods to a point from which the buyer can readily ascertain the cost of the remaining transportation to his desired point of final delivery.

More C.I.F. Prices Favored

The refusal of American concerns to quote c.i.f. prices on foreign business has been perhaps the most important of all causes of their failure to develop valuable export business. The universal practice of exporting houses in nations noted for their overseas trade is to assume the responsibility of delivery to the port of destination. The prices of various houses quoting at a given point are thereby placed on an equality and business is greatly facilitated. It is quite unnecessary for the manufacturer to keep on file all the necessary data regarding ocean freight and insurance, for, through an established export organization doing business in the two countries concerned, he can relieve himself of all details and expense. Through the services of the exporting house, the seller in the United States can quote the foreign buyer a definite and complete price in foreign money, for the goods delivered at foreign port, while at the same time making the sale for a definite sum in dollars payable in the United States. It is always best to quote the foreign inquirer in his own terms, because he is thus put in position to give his order instantly on receipt of the quotation, by a line to the exporter's branch in his locality. His purchase is thus made as easily as he could buy from a manufacturer in his own country.

Working for the Deferred Order

But suppose the terms of the inquirer indicate that an immediate sale is not possible, because plans must be made, financing arranged, or any other preliminary remains to be done in advance of any decision. Instead of throwing the letter aside, or sending a discourteously short reply directing the inquirer to apply again when he is ready to buy, the advantage of the inquiry should be held against competitors by increasing the writer's interest. Deferred business may come through at the very time when an order will be most welcome; and if it happens to come when there is already too much work in hand it is possible to refuse or to raise the price.

If the inquiry is preliminary only, a general answer may be more useful than an exact quotation. In countries not so well supplied with industrial plants as the United States, there are no such numbers of engineers available for planning and estimating the cost of projects for building or rebuilding factories, railroads and power plants, opening mines, or developing lumber tracts. A large sale of machinery may be ready to follow the pen-written letter of some non-technical man of means in a foreign country. If, therefore, a letter comes in bringing an inquiry for all the machinery necessary to equip a plant to make ten tons of nails per day, sizes not stated, or to manufacture paper, with no hint as to quantity or kind, the chance of big business is good enough to make a careful reply worth while. Imagination will reveal the writer, probably the most enterprising man in his town, searching out the name of the American manufacturer whose reputation for the equipment required is good, and writing with the intention of obtaining information sufficient for making a plan, estimating cost and getting together the necessary capital for the operation. A short answer will delay the project, disappoint the writer, and send him farther in his quest for advice, to land in the hands of trade rivals.

The answer to an inquiry of this kind ought to be a little treatise on the general subject, going clear outside of a specification and price for the machinery needed. The number and kinds of machines, the raw materials that may be used, the number of workers, horse power needed, average price of complete plants per unit of output, size of buildings, and time probably needed to construct a factory should be given. Catalogs and photographs should be forwarded at once. The labor of preparing formal specifications and computing firm prices may as well be saved, for the order cannot possibly be placed within any reasonable time limit for maintaining prices. With the general information and approximate prices may properly be sent question sheets to be used in returning exact information, for there must be a second letter of inquiry, and delay will be avoided by arranging for the second letter to bring all the data required.

Letters That Do Not Count

Sales departments are generally expected to devote a large part of their efforts to business which they lose. It is perhaps a fact that there is too large a proportion of salesmen's time wasted on business which they might reasonably anticipate that they cannot get, and that by recognizing this they could arrange to devote more effort to the portion which is reasonably likely to come through. It is a waste of time to write export sales letters which tell the inquirer less than he needs to know when he is ready to place his order, or to quote an exact price for something which he does not know that he wants. If the writer of export sales letters will put himself mentally in his correspondent's place, and look at the situation from that viewpoint, he will be enabled to write letters that will produce satisfactory results.

A Soldering Alloy for Steel, Iron and Aluminum

An alloy, consisting of 25 parts lead, 25 parts tin and 50 parts zinc and recommended as a suitable composition for soldering cast iron, mild steel, aluminum, etc., has been patented (U. S. 1,195,955) by William A. Day, Bellingham, Wash. To prepare the articles for soldering they are cleaned and then covered with stearic acid or a similar flux. The alloy is then applied with an extra hot soldering copper.

Platinum production in 1916 in Russia is estimated at 3600 to 4300 lb. or one-third of normal, according to the British Consul at Ekaterinburg, Russia. The rise in price is attributed to this decreased output as well as to the speculation by local buyers. The output has been affected by labor scarcity and the difficulty in securing mechanical parts for dredges.

How Machine-Tool Industry Has Expanded

Growth of Capacity and Output Both General and Large—More Extension Contemplated—Inadequate Labor the Distressing Feature

Through the courtesy of over 70 builders of machine tools THE IRON AGE is enabled to present herewith a comprehensive idea of the extent to which that industry has expanded to meet the demand for metal-working machinery in the past two years. Several entirely new plants are building, or are projected, but the greatest increase to capacity, and consequently to output, in the past two busy years has been accomplished by additions of floor space, new equipment and working forces.

A most serious drawback has been not only the lack of skilled labor but strikes on the part of the existing supply; otherwise the showing as to increased capacity would be even better than it is. Many tool builders had no heart to go ahead with the expenditure of money for enlarging their plants when they found it so difficult to get and retain a sufficient number of employees to properly man their shops. This distressing phase of the situation was overcome to a considerable extent by overtime work and engaging the services of outside shops.

In many cases tools of new design have been withheld from the market, one reason being that manufacturers were taxed to the utmost to supply the demand for their regular and already established lines; another being that some manufacturers have had no time to give to designing new tools. Newly designed machines are to be attributed chiefly to establishments comparatively young in the business.

One thought that suggests itself after a perusal of the information which the tool builders have supplied is that their industry has been one of its own best customers. Several state that it was through the installation of improved equipment that they were able to increase their output—a most important consideration in view of the labor situation.

At least three new and large plants are in course of construction, while the number of companies which have built new plants, additions or otherwise added to their floor space is well over 50. Three or more companies have purchased tracts of land which they will hold pending a more favorable time for building. Those who replied to requests for information have been listed in four groups: New England, Middle Atlantic, Middle West and Northern Central States, as follows:

New England

Baird Machine Company, Bridgeport, Conn.—Increased its equipment by 10 per cent and its capacity by 30 to 35 per cent.

Beaman & Smith Company, Providence, R. I.—Has built an addition 40 x 150 ft., four stories and basement, of reinforced concrete; added 12 machines to its equipment, increased its working force about 10 per cent and its floor space about 50 per cent.

Blake & Johnson Company (Machinery Division), Waterbury, Conn.—Has increased its floor space about 20 per cent, likewise its equipment, and increased its working force about 50 per cent. Increased capacity about 50 per cent.

J. G. Blount Company, Everett, Mass.—Has acquired 14,000 sq. ft. of land and enlarged its plant, increasing its floor space by 2600 sq. ft. Equipment has been increased by about 65 per cent and the working force by about 80 per cent.

Brown & Sharpe Mfg. Company, Providence, R. I.—By extensions has added 70,000 sq. ft. to its floor space, and in two years has added 2100 men to its working force. Has made many improvements on the machines in its regular line.

Bryant Chucking Grinder Company, Springfield, Vt.—Has made additions to its plant which have more than doubled its capacity.

Bullard Machine Company, Bridgeport, Conn.—Has largely increased its plant, plant equipment and productive capacity.

Fellows Gear Shaper Company, Springfield, Vt.—Has not added to its floor space, but has purchased about $30,000 worth of new equipment, increased its working force by 60 men and its capacity by approximately 20 per cent. It contemplates further expansion in 1917.

Geometric Tool Company, New Haven, Conn.—In 18 months has built two additions, increasing floor space about 30 per cent; added about 15 per cent of new equipment and increased its working force 90 per cent. Is now building a hardening department. Recently brought out a new size of the Geometric threading machine.

Grant Mfg. & Machine Company, Bridgeport, Conn.—Has increased its equipment 20 per cent, its working force 75 per cent and its capacity about 100 per cent. It plans further extensions.

Hendey Machine Company, Torrington, Conn.—Has added about 50 per cent to equipment as well as to working force, increasing capacity about 50 per cent. Contemplates the erection of a large foundry, also other extensions in the coming year. Has placed on the market a new 20-in. crank shaping machine which will be followed by other sizes.

Jones & Lamson Machine Company, Springfield, Vt.—Has built a new hardening and steel storage shop, approximately 100 x 120 ft., of fireproof construction; added $40,000 to $50,000 worth of new machine tools and increased its working force about 50 per cent as compared with two years ago.

Morse Twist Drill & Machine Company, New Bedford, Mass.—Has added a one-story addition, 40 x 85 ft., to one of its older buildings, built a new boiler house and engine room, about 65 x 100, and a new five-story building, 60 x 376 ft., which is to be fully equipped and occupied.

New Britain Machine Company, New Britain, Conn.—Has installed new equipment valued at about $50,000 and increased its working force by 50 per cent, increasing its capacity 100 per cent. It contemplates further expansion. It has added to its line a new six-spindle automatic screw machine. A little over two years ago the company added extensively to its floor space, some of which has only recently been utilized.

Rowbottom Machine Company, Waterbury, Conn.—Has extended its plant and doubled its floor space; also added 25 per cent to its equipment and output.

Standard Machinery Company, Auburn, R. I.—Has made various improvements. Has discontinued the making of producer gas and installed an oil system for heat treating and forging. Has added to its line of turret lathes, milling and boring machines and heavy planing machines. Has increased its working force about 35 per cent.

Standard Mfg. Company, Bridgeport, Conn.—In

the past year acquired the Parsons Foundry Company, which is now housed in a new building of steel, concrete and glass, 110 x 300 ft. A four-story addition increases the floor space over 200 per cent, while the equipment has been increased about 80 per cent and the working force 150 per cent. Capacity has been doubled, and it is the intention to add 25 per cent to the present floor space in the near future. Has installed four electrically-operated cranes, one of 10 tons and three of two tons capacity, also a 58-ton and a 20-ton cupola. Has made many improvements in its line and created a department for the making of milling cutters.

Stockbridge Machine Company, Worcester, Mass.—Has added extensions giving 6000 additional square feet, purchased $12,000 worth of new equipment, and increased its working force and its output about 25 per cent.

Universal Boring Machine Company, Hudson, Mass.—Is building an extension to its plant which will increase floor space about 50 per cent; is also adding new equipment. In the past two years has doubled its working force, and contemplates a further increase. Plans to place new machines on the market.

Universal Grinding Machine Company, successor to Bath Grinder Company, Fitchburg, Mass.—Has increased its floor space 4000 ft.; increased its equipment by 10 per cent; enlarged its working force by 25 per cent, and increased its output 33 per cent.

Whitcomb-Blaisdell Machine Tool Company, Worcester, Mass.—Has made moderate additions to plant; none to machine shop, but 3000 sq. ft. has been added to foundry. Working force has not been increased beyond normal, and capacity has not been increased.

A New England company manufacturing drilling machines has added about 20,000 sq. ft. to its floor space, 10 to 15 per cent of new equipment, and increased its working force 20 per cent, likewise its capacity.

Middle Atlantic States

Birdsboro Steel Foundry & Machine Company, Birdsboro, Pa.—Has added a new roll foundry and shop, 60 x 240 ft., fully equipped with modern tools and equipment; built an extension to its steel foundry, 60 x 60 ft., and has under construction a core building, 40 x 100 ft. The power plant has been changed over for the purchase of electric power, and many other improvements made. Has increased its working force about 20 per cent, and the capacity of the plant about 100 per cent. Has placed on the market heavy-duty roll lathes of special design.

Bridgeport Machine Tool Works, Rochester, N. Y.—Has leased outside shops enabling the past year's output to be increased 8 to 10 times over that of any previous year. The company has lately acquired title to additional property which will increase its floor space by 100 per cent.

Dalton Machine Company, New York City.—Has increased the floor space of its present plant by 15,000 sq. ft., also has purchased six acres of land and expects to build in the spring. About $25,000 worth of new equipment has been purchased by the company, its working force increased 30 per cent and its capacity 50 per cent. Has placed a new line of engine lathes on the market.

Davis Machine Tool Company, Inc., Rochester, N. Y.—In October, 1915, acquired the plant and business of the W. P. Davis Machine Company. The present plant consists of 3 buildings with about 85,000 sq. ft. of available floor space, approximately 25,000 ft. of which was under lease at the time the property was acquired. The equipment has been increased about 25 per cent and the working force and production about 300 per cent. In the past year the company has brought out a 12-in. tool-room lathe, a 20-in. drilling machine, and added a new shaper, which is being built in sizes 14, 16, 20 and 25 in.

Gould & Eberhardt, Newark, N. J.—Have under construction a new plant which will increase the floor space from 65,000 to 135,000 sq. ft. Tools have been purchased for the new plant. Working force has been increased from about 500 to 750 men and the capacity of the new plant will be about 50 per cent greater than that of the old one.

Hilles & Jones Company, Wilmington, Del.—Has under construction a new storehouse and stock-room, but no further expansion of shop is contemplated at this time. Has replaced some old equipment, and is running night and day with as large a force as is available under present conditions.

Landis Machine Company, Waynesboro, Pa.—In the past few years has increased its floor space at least 100 per cent, added greatly to its equipment, and to its working force fully 50 per cent. Has about doubled its output. Is stated to be the largest plant in the world devoted exclusively to the manufacturing of threading machinery.

Meisselbach-Catucci Mfg. Company, Newark, N. J.—In the past year has added about 35 per cent additional floor space and increased its equipment about 10 per cent. Has enlarged its working force but not to the desired extent.

Newton Machine Tool Works, Inc., Philadelphia, Pa.—Has increased its actual floor space about 15 per cent, while a better utilization of other space has been effected. Considerable new equipment has been added. The working force, until the 8-hr. strike in Philadelphia, had been increased about 40 per cent. The capacity of the plant has been practically doubled.

Pryibil Machine Company, New York City.—Has added new equipment to the amount of 30 per cent and increased working force about 50 per cent. Has placed a new stud, or small engine lathe, on the market (non-screw cutting).

Royersford Foundry & Machine Company, Royersford, Pa.—In the past year has added an extension, giving 12,000 additional sq. ft., which is used as a stock room and assembling room for 10, 14 and 20 in. drill presses. Has just entered an export order for eight of the largest punching and shearing machines it manufactures. Y. C. Freed, who was the founder and sole owner of the company, has retired, his interest having been purchased by Frank H. Deisher and H. R. Willi.

William Sellers & Co., Inc., Philadelphia.—Has acquired 46 acres near Philadelphia on which it is the intention first to erect buildings for foundry work and the company's transmission department, so that the space now occupied by these departments may be used for extending its machine shops in Philadelphia. Building is awaiting favorable conditions.

Seneca Falls Mfg. Company, Seneca Falls, N. Y.—In the past year has moved into a new plant for the reason that the State of New York took over the old plant for Barge Canal construction. Its new plant has approximately 20 per cent more floor space than the old one. Has not been manufacturing some sizes of lathes, but concentrating on other tools of its line.

Watson-Stillman Company, Aldene, N. J.—Has increased its machine-tool equipment about 15 per cent, and its capacity is about 10 per cent greater than in 1915.

Zeh & Hahnemann Company, Newark, N. J.—Has enlarged its plant about 50 per cent, likewise its equipment and output. The bulk of the company's business has been patent percussion power presses, which are extensively used for producing hot pressed brass parts.

A New Jersey tool-building company has built a new concrete factory.

A Pennsylvania company manufacturing boring mills and drill presses has added about 10 per cent to its equipment and increased its capacity 15 to 20 per cent.

Middle West

Acme Machinery Company, Cleveland, Ohio.—Has purchased new equipment to the amount of about $30,000, increased its working force about 40 per cent and its capacity about 30 per cent.

American Tool Works Company, Cincinnati, Ohio.—Is building a plant of reinforced concrete construction which will be completed in the early part of 1917. It will contain 240,000 sq. ft., representing a considerable increase over present floor space, and offer working accommodations for approximately 1500 men.

Bardons & Oliver, Cleveland, Ohio.—Have increased their equipment and working force to a moderate extent.

Cincinnati Lathe & Tool Company, Cincinnati, Ohio.—In two years has increased its capacity about 50 per cent, including buildings, equipment, floor space, etc. Production has not increased over 15 per cent because of inadequate labor supply.

Cincinnati Electrical Tool Company, Cincinnati, Ohio.—Has extended its plant by 5000 sq. ft., purchased new equipment, increased its working force about 20 per cent, its capacity about 30 per cent, and is contemplating further expansion.

Cincinnati Planer Company, Cincinnati, Ohio.—Has extended its plant by adding about 15,000 sq. ft. of floor space, added 20 per cent of new equipment, and increased its working force and capacity in the same ratio. It contemplates further expansion.

Cleveland Milling Machine Company, Cleveland.—Established a plant for the manufacture of milling cutters and milling machines.

Fox Machine Company, Jackson, Mich.—Has built and equipped a new plant. Machine shop is 90 x 312 ft., of monitor type construction, with traveling crane running down center. Foundry is 90 x 200 ft., also monitor type construction, and equipped with traveling crane. Offices and engineering department occupy new building 45 x 45 ft. Is building a 2-story fireproof addition, 30 x 90 ft., for the storage of patterns. Has increased its capacity 50 per cent. Has placed one new type of machine on the market in the past year, and in a few months will bring out improvements to others.

Greaves-Klusman Tool Company, Cincinnati, Ohio.—Has sold almost all of its old equipment and replaced it with the latest types of machinery. Has not increased its working force, and its capacity is the same as prior to the war so far as its Cincinnati plant is concerned, but is working three good-sized shops outside of Cincinnati which are producing three sizes of machines, so that its production is more than three times what it was prior to 1916. Contemplates acquiring or building a new plant, but plans are not formulated.

Houston, Stanwood & Gamble Company, Cincinnati, Ohio.—Has added a large amount of new equipment such as lathes, gear cutters and planing, drilling and milling machines. Has increased its working force of machinists about 40 per cent and its capacity about 50 per cent. In the last two years the company has designed and introduced a line of heavy duty lathes, double back-geared and triple geared, including 30, 36 and 42 in. machines. Has also brought out lathes of corresponding sizes with selective speed headstocks.

Lodge & Shipley Machine Tool Company, Cincinnati, Ohio.—Has replaced about 10 per cent of its equipment, increased its working force 10 per cent and its capacity by 25 per cent, the greater output being due to increased working force, better equipment and improved methods.

Lucas Machine Tool Company, Cleveland, Ohio.—Has increased its floor space 25 per cent, added new equipment and increased its working force and its capacity about 15 per cent.

Massillon Foundry & Machine Company, Massillon, Ohio.—Has purchased 12 acres of land in Massillon and is putting up a new building, the principal section of which will be a machine shop 700 to 750 ft. in length, 100 ft. wide, with a 50-ft. crane center. The present plant has not been enlarged except to the extent of abandoning the foundry department and installing therein sufficient machine-tool equipment to increase capacity by 50 per cent. The new plant will have 50 to 75 per cent increased floor space. Has slightly enlarged its working force by additional men and overtime.

National-Acme Mfg. Company, Cleveland, Ohio, and Windsor, Vt.—Within the year has acquired the Windsor Machine Company, manufacturer of the Gridley multiple and single spindle automatics. Has extended Cleveland plant approximately two acres, giving floor of about ten acres. In practically all of the new space is new equipment. The working force has been increased about 25 per cent, and capacity about 20 per cent, covering both plants. The company has recently acquired fourteen acres, upon which has been constructed a plant of about six acres to provide for the parts end of the business. The present Cleveland plant will then be turned over to the manufacture of automatics, special screw cutting machines, self-opening dies and collapsible taps. Has placed on the market a new collapsible tap.

Sidney Tool Company, Sidney, Ohio.—In the past year has built a two-story building, 50 x 92 ft., for assembling purposes, enlarging its floor space by approximately 10,000 ft. Has increased its equipment by about 33 per cent, and increased its working force 40 per cent. Has placed on the market a line of heavy duty engine lathes.

Simplex Machine Tool Company, Cleveland, Ohio.—Is enlarging its Hamilton plant about 60 per cent by the erection of a new building, 60 x 238 ft. Has also increased its equipment and working force. In addition the company has purchased a plant at Columbus, Ohio, where 150 men are employed, the force being enlarged as rapidly as possible.

Smith & Mills Company, Cincinnati, Ohio.—Has extended its plant, adding 3000 sq. ft. of floor space. It has bought new equipment moderately; increased its working force by 15 per cent and its capacity by 25 per cent.

John Steptoe Company, Cincinnati, Ohio.—Has added a one-story building, 60 x 108 ft. The capacity of the plant has been doubled by adding new equipment and doubling the working force. Another building is contemplated, and probably will be built in the latter part of 1917.

United States Electrical Tool Company, Cincinnati, Ohio.—Has increased its plant and working force 50 per cent, increasing its output 40 per cent. Will enlarge its capacity by taking another floor of its building, thereby gaining about 30 per cent more space. Will use additional machines and men.

A company manufacturing turret lathes has increased its floor space 45 per cent. Prior to the war it employed about 350 hands, whereas it now has about 1200.

A Middle Western company building gear-cutting machinery has added to its equipment by 20 per cent; increased its working force by about 75 per cent, and doubled its output in the past two years.

A Middle Western maker of turret machinery has started a subsidiary plant which has 15,000 sq. ft. of floor space, and is fitted with new machines and equipment. Machinery in main plant has been increased. The working force has been increased from 130 in October, 1914, to 450 and 500 men, including both plants.

A shaping machine company in the Middle West has increased its output 100 per cent as compared with two years ago. It has added 20 per cent of new equipment and increased its working force by 75 per cent.

A Middle Western company manufacturing radial drills has added 10 per cent floor space by extensions and has substantially added to its equipment, but has not increased its working force. Its increase in output is but nominal, but it contemplates further extensions in the coming year and will bring out new machines when a favorable time arrives.

Northern Central States

Adams Company, Dubuque, Iowa.—Has bought several thousand dollars' worth of machinery, doubled its working force and increased its capacity by 100 per cent. The company contemplates further expansion.

Barnes Drill Company, Rockford, Ill.—Has enlarged its floor space by 6500 sq. ft., and is adding $8,000 to $10,000 worth of equipment. The new extension will enable the working force to be increased by about 25 men, which will make the percentage of increased capacity about 25 per cent. Has improved its line of all-geared drills and self-oiling drilling and tapping machines.

Gardner Machine Company, Beloit, Wis.—Has completed an addition giving approximately 8500 sq. ft.

more floor space, the extension being a continuation of the original building, which is of reinforced concrete construction. Has also erected a power house equipped with two Uniflow engines direct-connected with Crocker-Wheeler generators, developing about 200 hp. Has also installed a Pawling & Harnischfeger five-ton crane. Tool purchases have been small but the working force has been increased about 100 per cent, and the increased capacity is proportionate.

Ingersoll Milling Machine Company, Rockford, Ill.—Has made extensions which about doubled its floor space and production of 1915.

International Machine Tool Company, Indianapolis, Ind.—In the past two years has added twice to its plant, more than doubling its floor space and equipment. Its working force has also been more than doubled.

Moline Tool Company, Moline, Ill.—Has built a new plant, increasing its floor space 200 per cent; added 100 per cent of new equipment; enlarged its working force 50 per cent and contemplates further expansion.

National Automatic Tool Company, Richmond, Ind.—Has made three additions to plant, gaining 35,000 to 40,000 sq. ft. Since Jan. 1 has increased its equipment 125 per cent. Working force has been increased from 60 to 275. In 1914 the company's output was approximately $100,000; in 1916 it was close to $1,000,000. New buildings are contemplated. Several machines have been added to the company's line of multiple spindle tapping, reaming and drilling machines.

Pierce Machine Tool Company, Chicago, Ill.—Since last May has doubled its floor space, likewise its manufacturing equipment. Its working force has been increased 30 per cent and production about 50 per cent. Contemplates further expansion to care for a new 1⅝ x 11-in. patent friction back-geared screw machine to be placed on the market.

Rockford Drilling Machine Company, Rockford, Ill.—Property has been considerably improved, and the output doubled by installing additional equipment and increasing the working force. An industrial railway system has been put in the foundry, and a new pattern-storage room provided. A larger pattern shop is under way and a two-source sprinkler system is being installed.

Wickes Brothers, Saginaw, Mich.—Have built an extension to foundry, added about 2000 sq. ft. and 30 machines to machine shop, and increased working force about 60 per cent. Working a small crew nights has raised capacity more than 75 per cent. Has placed a new line of lathes on the market, including a 17-in. single purpose, rapid production lathe for automobile parts or any work where the operation is repeated. Also manufactures 20, 26 and 32-in. lathes.

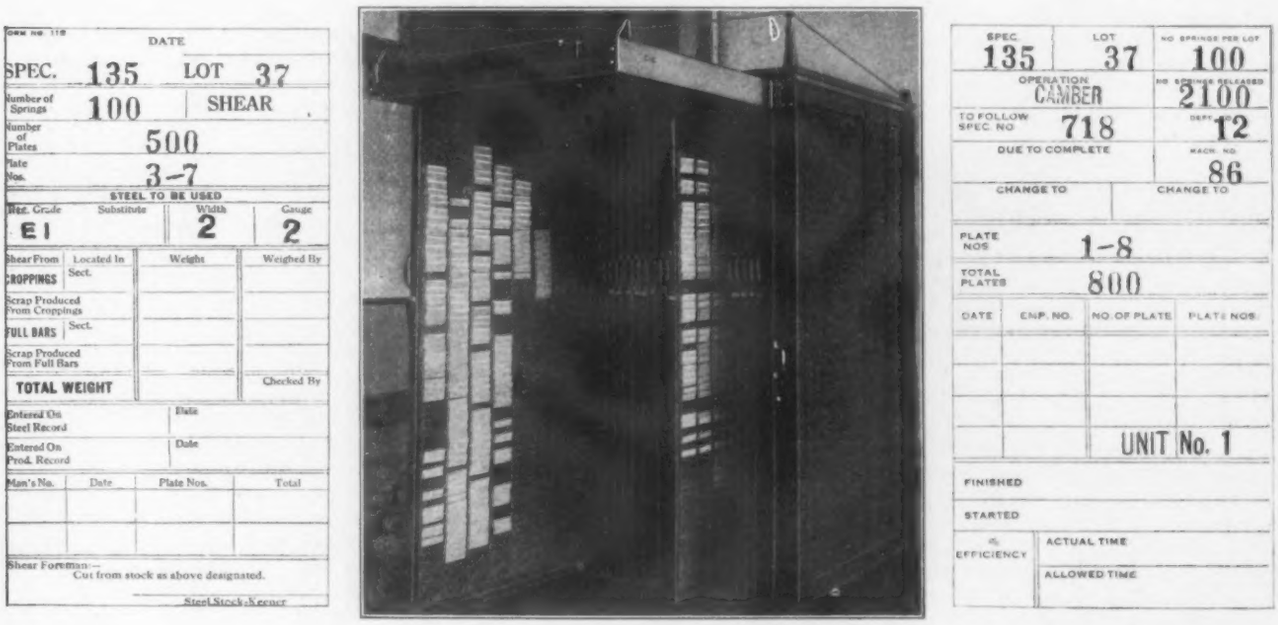
Wilmarth & Morman Company, Grand Rapids, Mich.—Has built two extensions, thereby increasing floor space more than 100 per cent, also doubled its equipment and more than doubled its working force and output. Has placed a new universal grinder on the market, on which it is sold up for months.

Unit Method Used in Operating Plant

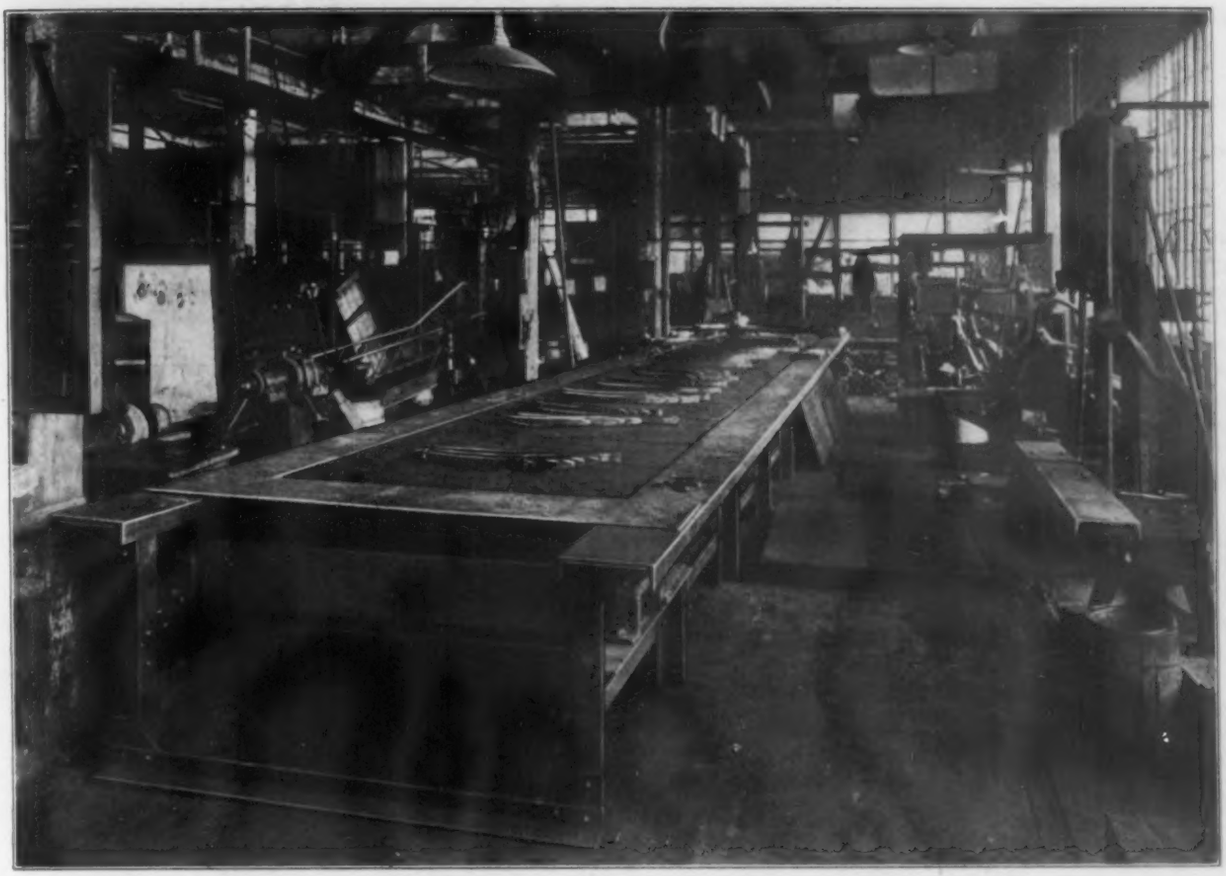
Production Scheme of Standard Parts Company in Making Springs—Unique Committee Plan Extends All Through Organization

BY F. L. PRENTISS

Adopting a radical departure from the usual modern plant practice of grouping work according to the character of the operation in separate departments and bringing the completed parts together in one final assembling department, the Standard Parts Company, Cleveland, Ohio, has effected a complete reorganization of the manufacturing methods in its automobile spring plant. This involved almost an entire rearrangement of the plant, which is now operating as six separate units, each unit being a complete manufacturing plant by itself, with a separate organization. These changes in the manufacturing methods and the present plan of plant organization were adopted when the company was operating under the old name of the Perfection Spring Company, but the management is virtually the same as before its recent reorganization, when the Standard Welding



The Planning or Control Board Which Consists of Sliding Metal Panels Inclosed in a Metal Case and Provides 19,200 Pockets for the Shear and Operation Cards Reproduced at the Left and Right Respectively, the Cards for a Certain Order Being in the Same Vertical Row While Those for Similar Operations Are Grouped in a Horizontal Row



The Assembling End of One of the Manufacturing Units into Which the Plant Is Divided with the Electrically Operated Conveyor Table in the Foreground, the Machines Used in the Assembling Operations Located on Either Side of the Table and the Wire Netting Separating Two of the Units in the Background at the Left

Company was consolidated with it, and the merger will not affect the manufacturing methods and organization plan as described.

This company has kept pace with the growth of the automobile industry, and from a small beginning a few years ago it is turning out about 4500 automobile springs per day. With the rapidly increasing output, which would ordinarily require a corresponding increase in floor space, former manufacturing methods were found to be unsatisfactory in that they required too much handling of material and moving of parts in the process of manufacture through too great distances from one part of the plant to another for succeeding operations. The plant organization itself is unique, the dominating feature of this being the existence of numerous committees, starting at the top with the executive committee and reaching down through the various executives and heads of departments to a committee composed of foremen of the various units.

At the head of the plant organization, under the works manager, is the general superintendent, and under him an assistant over all the units. The work time in the plant is divided into three 8-hr. shifts, and all departments are operated on multiples of 8 hr., some running one and others two and even three shifts. There is a superintendent and an assistant for each shift. Over each unit are a forge and a finishing foreman. Under the works manager there is, in addition to the general superintendent, a machinery superintendent, having charge of machinery, equipment, and buildings; the production manager, having charge of the stock and planning; an employment manager, and a warehouse superintendent. It will be noted that instead of requiring a general superintendent with expert knowledge of all lines of manufacturing work, the various responsibilities are split up in the above four divisions, making it possible for the three-shift superintendents to devote their entire attention to the execution of production orders.

An analysis of the production methods formerly followed clearly indicated to the management that the problem of reducing production costs by improved methods was largely one of transportation, and the solution was the reduction of the distance of handling material between operations and providing suitable mechanical means for moving this material in the process of manufacture. The mechanical features of the system include a crane in the warehouse for handling steel from cars, the use of electric trucks for hauling material from the steel warehouse to the manufacturing department, and conveyor furnaces and tables used during the manufacturing operations.

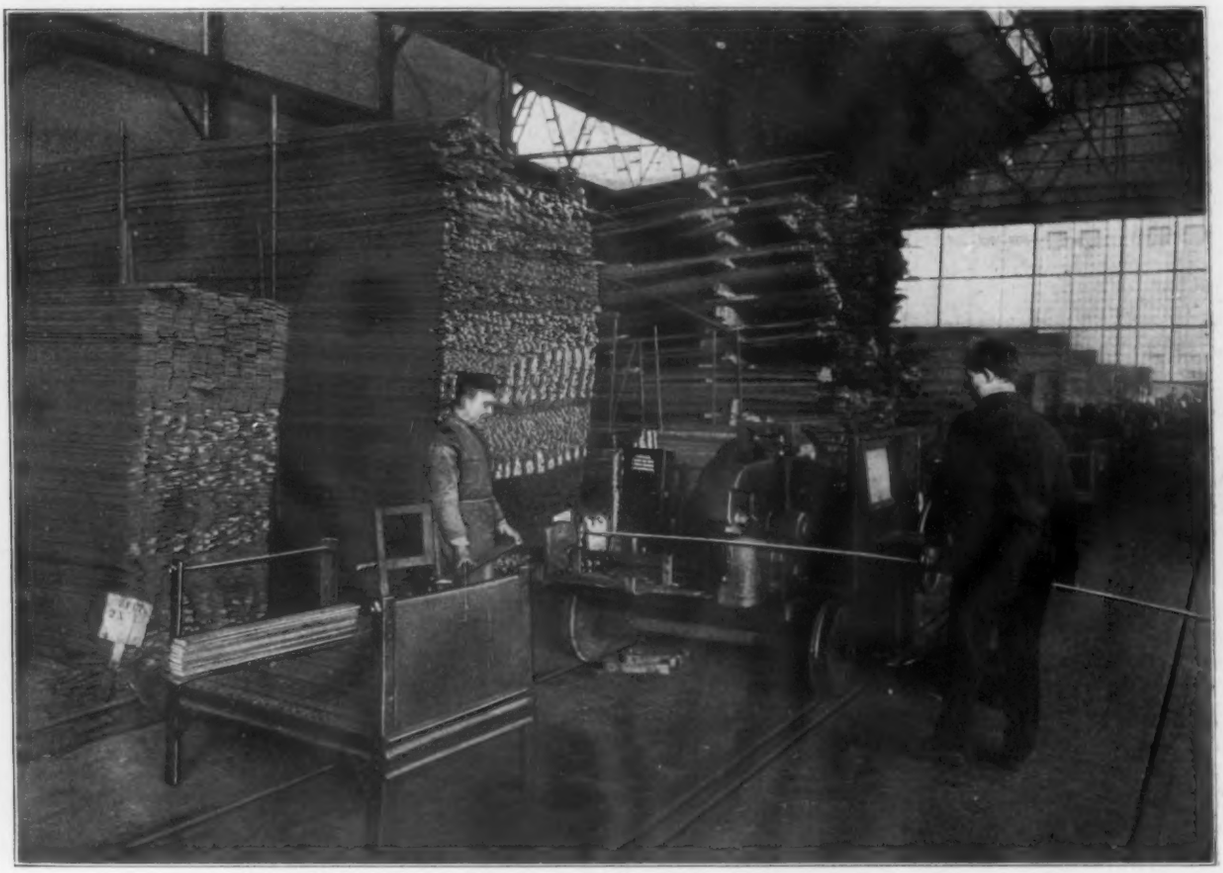
The advantages claimed for production under the unit system include direct travel of the work from the time the tractor takes the raw stock of steel from the warehouse to one of the manufacturing units; the avoidance of danger of work becoming mixed, as only one kind of spring is made in one unit at one time; the absence of "stragglers" or shortage in cleaning up work; the specialization by men on certain operations, permitting them to develop the highest state of efficiency; the maximum production in a minimum amount of space; the minimum amount of handling during the production processes; closer supervision over any customer's work; a smaller amount of material in the process; quick filling of rush orders by following regular routing methods, and better quality of the product. It also provides a very flexible system of handling a varying volume of business, in that one or more units may be shut down or started up as deliveries may demand.

That the unit plan has worked out most successfully in this plant is indicated by the statement that the production has been doubled with only a

small increase of floor space. Under this plan finished springs can be taken to the shipping room in 4½ hr. after the raw material has left the stock piles, and the quantity of material in process of manufacture throughout the plant has been reduced 80 per cent. Although two units are seldom, if ever, engaged in making the same type of spring at the same time, the unit plan as adopted suggests interesting possibilities in the way of keeping close comparative records of the production in the different units with a view of stimulating rivalry between them for record outputs, and learning the cause if one or more units fall considerably behind the others in production. However, as the system has only recently been placed in operation, little has been attempted as yet in this direction.

The manufacturing units occupy a floor space 30 x 250 ft. each in the main, one-story factory building and are entirely separated, each being inclosed by a 8-ft. heavy wire netting fence. Entrance openings are provided at each end, the raw material going in through one and the finished product coming out at the other. The adoption of the unit plan has necessitated an entire rearrangement of the machinery in the plant. The equipment is arranged in sequence of operations, the steel going in at one end of the unit and coming out of the other as completed springs, without a backward movement during the manufacturing operations. The units are practically identical in equipment, the only difference being that some are fitted for turning out light and some for heavy work. Each unit is divided into four departments. The first is the forging department, that includes all operations in getting the work ready for cambering; the second is the cambering and heat-treating department, which includes heating, cambering and drawing; the third is the finishing department, which is the assembling of the springs, and the fourth is the inspection department, all inspections of springs made in one unit being done in that unit.

About 75 men are employed in each unit on the combined three shifts. The equipment in each unit consists of one heating and one drawing furnace, each having two separate compartments; one grinding machine, one bushing press, three polishing machines, one riveting machine, three vertical drilling machines, two testing machines, eight cambering machines and one conveyor table. After leaving the drawing furnaces the spring leaves are taken to the fitter, who, when he finishes the work, loosely arranges the leaves on the electrically driven conveyor table. One of these tables is installed in each unit as a step in the cutting down of the manual handling of the material. These tables are 45 ft. long and 6 ft. wide, having a conveyor 4 ft. wide and a stationary section 1 ft. wide on each side. The conveyor has wide steel flights, making a continuous level metal surface. Adjoining the narrow aisles on each side of the table are located the machines used in assembling the springs, these operations including cleaning the scale off on polishing wheels, bushing, milling and reaming the eyes, riveting the clips, bolting up, testing, etc. The workman takes the spring from the conveyor table, performs his operation, and places it back on the table, and it moves along to within convenient reach of the next assembler.



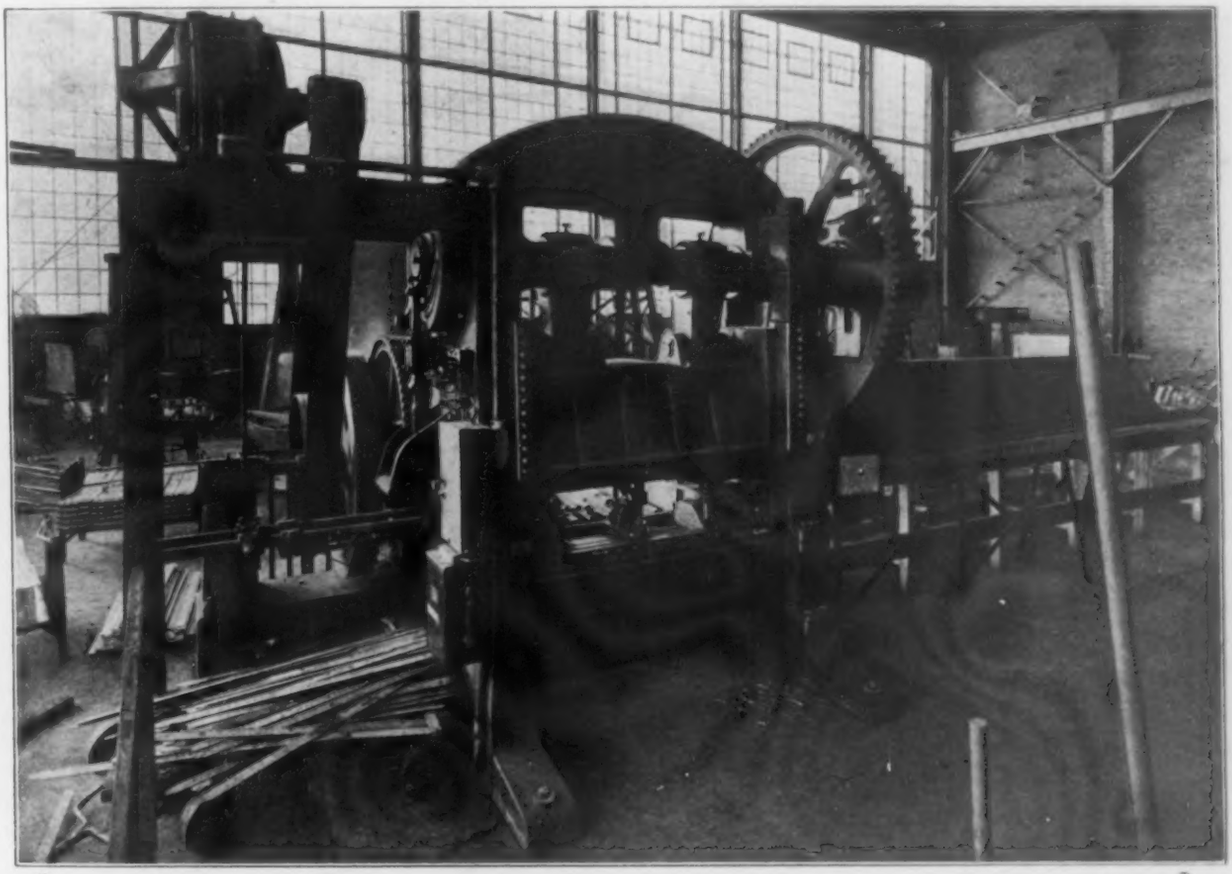
The Stock After Being Cut to Length by Portable Electric Shearing Machines in the Steel Warehouse Falls on the Rack Back of the Machine and the Shearman's Helper Places It on the Platform at the Left Which Is Handled by an Elevating Platform Electric Truck

The raw stock of spring steel is stored in a very conveniently arranged steel storage warehouse recently erected. This is 380 ft. long and 105 ft. wide, without an interior building column and with a cement floor. This is served by a 6-ton crane which unloads the steel stock directly from cars on a switch track at one side of the warehouse and places it in storage piles. As the location made it impracticable

tical to run a railroad siding into the building, cars are run on to a track at one side of the warehouse and transferred to a track within by a 75-ft. transfer table furnished by the Whiting Foundry Equipment Company and from the table they are run over track scales. A separate stock pile is kept for each grade of steel and for each size. After the steel is unloaded in the warehouse it is gaged, test samples are cut off and tests are made of every heat to determine both the chemical and physical properties before the material goes to the manufacturing plant. An unusually well equipped laboratory is provided for testing. The laboratory department specifies the temperature and time for the heat-treating operations in the heat-treating departments and all records secured through the complete recording pyrometer system are always checked up in that department, the manufacturing department merely carrying out the orders of the laboratory.

The stock is sheared into required short lengths before leaving the warehouse and a great deal of labor in handling stock is avoided by taking the shearing machines directly to the stock instead of moving the stock to the machine. Several electrically operated portable machines are provided for this purpose. These are mounted on trucks that run on two standard-gage tracks extending the length of the warehouse through the center of the building with the stock piles on either side. Plugs are located at convenient points in the floor to make connection for current. The two tracks have three rails, the center one being an inner rail for each track. When it is desired to move one of the portable shearing machines from one track to the other or past another machine standing on the opposite track this is quickly done with the crane. The stock after being sheared is placed on specially designed steel racks or platforms standing on legs that permit their handling with electric trucks having elevating platforms. Several trucks built by the Automatic Transportation Company, Buffalo, N. Y., are used in conveying the steel from the warehouse to the manufacturing plant and in moving the material from one section of a unit to another during some of the manufacturing processes.

A specially designed punching, shearing and trimming machine that effects a great saving in labor has been installed recently in the warehouse. This machine punches a hole in the center of the spring plate and trims the two ends with one stroke of the press. In the trimming operation a notch that forms the ends of two plates is cut in the stock and in the succeeding stroke of the press the stock is sheared at the center of the notch and another notch is cut at the opposite end of the plate. The machine has an open housing at one side through which the stock is fed. The material is fed and guided into the machine by rolls operated through chains and bevel gears and the machine is equipped with a magnetic trip, making it automatic in operation. The machine was built by the D. H. Stoll Company, Buffalo, N. Y.



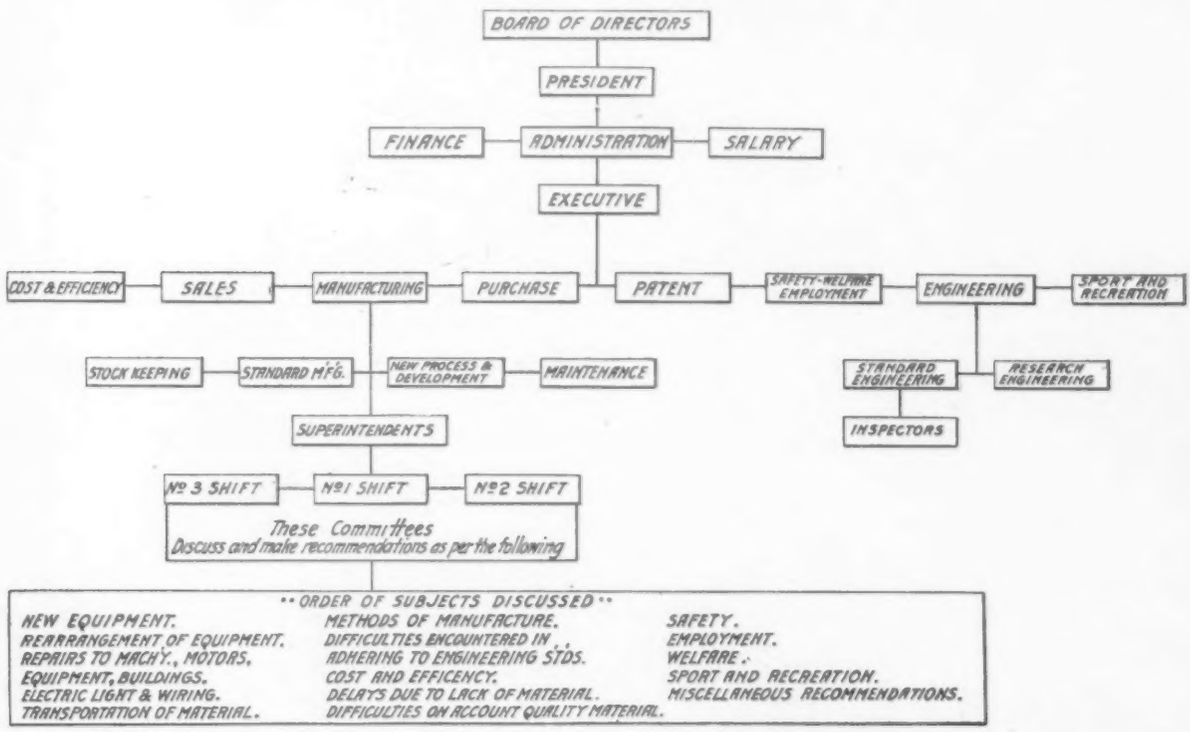
A Special Punching, Shearing and Trimming Machine That Punches a Hole in the Center of a Spring Plate and Cuts the Notches to Form the Ends of Two Plates at One Stroke, While the Next Stroke Cuts Them Apart and Notches the Opposite End of the Plate

Fuel oil for the furnaces and heating plant is discharged directly from tank cars into two 30,000-gal. underground tanks from which it is distributed through the plant by a pumping system.

A production system has been developed that is suited to the special requirements of a plant manufacturing springs on a large scale. The bulk of the output is the filling of contract orders with varying monthly specifications for front and rear springs for different models of cars. Small orders, however, make up the bulk of the work handled. Out of an average of about 500 orders per month, practically 90 per cent are for lots of less than 100

springs. On receipt of an order by the sales department, it is passed over to the engineering department, which prepares the specifications and bill of material. On the completion of the specifications the engineering department turns the tracing over to the order department, which makes out the production order which goes to the production department. The latter department is divided into two divisions, the material division and the planning division. A copy of the production order goes to the material division, which figures out the requirements for steel and parts. The material division notifies the planning division as to the material required to fill the order; in fact, issues the requisitions on the stockroom for the material needed. No order is released to the factory until all the material needed is on hand. This is because of the short time required in carrying the order through the manufacturing units, not over 4 or 5 days being ordinarily taken from the time of the first or shear-plates, the largest piece in which the eyes are formed being the main plate and the smaller plates that go to make up the spring being symbolized by numbers. The shear card also has spaces to indicate the grade and size of steel wanted; a space to show whether it is to be sheared from short lengths of stock, known as "croppings," or from full length bars, as well as weights of full bars and croppings cut and scrap produced.

The steel stock-keeper fills in the space on the form indicating the location of stock and the card goes to the shear foreman, who cuts it according to the specifications. The shear card goes from the steel warehouse to the material division, where it is entered on the steel stock record and an auxiliary blue shear-operation card made out in the warehouse is sent to the planning department, this card being placed in the control board to show that the lot is completed. In filling large orders, the lot numbers run up to 99 and start over again with 1.



The Committee Plan of Operation Which Extends Down Through the Plant from the Executive Committee to Minor Organizations Dealing with Manufacturing Methods, Welfare, Recreation, Safety, Etc.

ing operation until the completion of orders for from 5000 to 10,000 springs. When the planning department is able to release the order it refers to the planning board to ascertain to what unit the work can be assigned. When this is determined it makes out shear and operation cards and issues requisitions for the blueprints, which are distributed among the various departments concerned.

The shear and operation cards are the two essential forms used in the system of controlling production and routing work. There are from 7 to 15 operations in making springs, depending on the specifications. The work is routed through the plant in lots of not over 3600 lb., and a separate shear and operation card is issued for each lot and for each operation. The shear card is both a requisition for the stock and an operation card, being authority for shearing the stock. The shear and operation cards are 3 x 5-in. yellow cards which show specification number, lot number, number of springs in the lot, total number of springs released, number of plates and plate numbers, time order is to be completed, machine number and the unit to which the lot is assigned. The sheared stock is designated as The material, as it is sheared, is placed on two truck platforms which are carried to the scales at the end of the building. One platform contains the main plates and the other the rest of the plates for a particular lot of springs that is going through the plant. The two lots have a somewhat different routing, as the main plates go to the eye-forming department in the warehouse before being taken to the unit assigned. A truck card bearing the specification and lot numbers as filled out by the planning department accompanies each platform from the time the stock is sheared until the work reaches the cambering machines where the main plates and shorter plates come together to form a complete spring. This truck ticket is of heavy cardboard about 7 in. square.

From the warehouse the two platforms of stock are hauled by electric trucks to the semi-finished stock distributing room adjoining the manufacturing units, where it remains until it is due in the unit, to which the lots are carried on the same platforms. As the operation cards, except the shear and eye-forming cards, are released, the planning division sends them to the man in charge of the

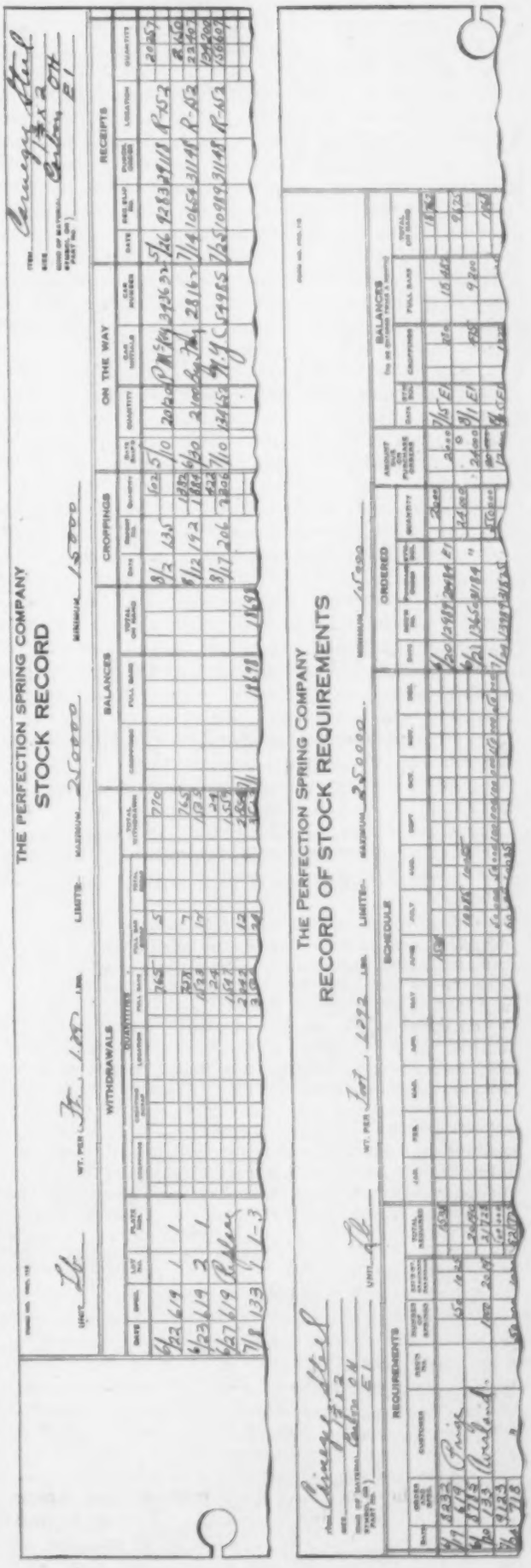
forge stockroom. He keeps them in a rack with separate pockets for each unit and each lot number. This man places the operation cards in a box at the entrance to each unit, keeping cards for two or three operations ahead of the work that is in progress on that lot in the box. These cards are taken out by the foremen and distributed to the men. The operation cards are in reality the operators' authority for work and they must be presented to the timekeeper to have both the time of starting and finishing work stamped on them. The decimal system, covering a 24-hr. period, is used in recording time, starting with zero at 6.30 a. m., 0.5 at 7 a. m. and on up to 23 at 5.30 a. m.

When the work is finished the operation card is placed in the finished operation pocket, where they are collected half hourly and returned to the planning department to be placed on the planning or control board. When an order is released by the planning department this is indicated by the insertion of time schedule cards—one for each operation of each lot—in the proper pockets of the planning board. As operations are completed the returned cards are placed in their respective pockets and special attention called to any that are trailing behind the schedule. As springs are inspected and passed for shipment the quantities are noted on the inspection card, which is very similar to the operation card. When a lot is finished as shown by the entries on the inspection card, the cards representing this particular lot are removed from the planning board. One employee is kept on duty in the planning room during the night shift.

Adjoining the operation card box at the entrance to each unit is a bulletin board on which is posted the production schedule of the unit for about a week. This shows the specification and lot numbers the men are to work on, the number of springs per lot, the assignment of lots to the three different shifts for the different days and the standard production per shift. Space is also provided on the same bulletin for noting any shortages ordered and for piecework prices. At present the gang bonus system is used only in the cambering department and, with a few exceptions, the individual bonus system in the forge departments.

The planning board consists of 20 sliding metal panels 29 in. wide and 50 in. high inclosed in a metal case occupying a floor space of only 3 x 6 ft. Cards are placed in pockets of fabric leather on each side of the panels, there being 480 of these pockets on each side of a panel or 19,200 pockets in all. The cards are arranged in pockets according to specifications, lot numbers and operations. A vertical row contains cards for a certain lot number and the horizontal row the cards for similar operations. Cards missing from the panel indicate that the operations represented by these cards are being performed in the plant. The form of planning board used has an advantage over the ordinary wall board of the tag and hook type in that it takes very little space and provides a large number of pockets within easy reaching distance from one point.

A record of the material in stock is kept on large loose-leaf forms that are contained in a binder. This record shows the material withdrawn from the stock in pounds of croppings and full bars, the croppings and scrap produced, the total material taken from stock and the balance left in stock in full bars and croppings. The balance on hand is totaled once a month. The stock withdrawals are entered on this sheet from the yellow shear cards that come to the material record department from the steel warehouse. A separate stock record is filled out for each grade and size of steel used, involving 275 items.



The Two Forms Employed for Keeping Track of the Stock on Hand and That Required to Fill Orders

Spaces are also provided for material received and on the way. Reference to this record shows at any time the amount of stock on hand for any kind and size of steel covered by the record. A stock record which is practically similar is kept for stock other than spring steel.

Records of stock requirements are posted on large loose-leaf sheets the same size as the stock records, a separate sheet being used for every part and every size of part. These records are made out in accordance with delivery specifications received from the order department. This stock requirement record shows the stock required for the production of monthly quotas of springs, these being noted in pounds under each month. Space is provided for entering the amount ordered, the balance left on hand in full bars and croppings and the maximum amount to be kept in stock.

The entire plant is operated under a committee plan, the committee organization extending down through the works from the general executive committee, which has charge of the execution of all matters pertaining to the manufacture and sale of the product as directed by the policy of the board of directors represented by the president to organizations of the foremen in the three shifts and units, the minor committee organizations having sub-organizations of committees on safety, recreation, welfare, methods of manufacture, etc. The president is at the head of the executive and administrative organization and there is no title of general manager, it being understood that the president is general manager. There is an assistant general manager who is chairman of the executive committee and is entirely responsible for the actions of that committee, having veto power and final decision. In fact, down through the committee organizations the chairman of each committee is responsible for the committee's work. In the preface to a pamphlet on the organization and administration the purpose and scope of the committees is briefly outlined as follows:

"It has been the aim of the management to be constructive and secure a consensus of opinion on all of the important activities of this company through the medium of committees. It is perhaps unnecessary to say that in order not to destroy the good to be secured by decisions which are the result of careful study and analysis of the members of the different committees, no employee of this company except the president or assistant general manager should in any way undertake to change or cancel any decision as rendered by a committee without first consulting the chairman of that committee. If, in his opinion, the change is of such minor importance that it is not necessary to call a committee meeting, he may authorize this change over his signature. If, on the other hand, the suggested change is for the betterment and is an important one, it should be submitted to the committee by the chairman for their decision."

There are 13 general committees, including the purchasing committee that meets every day; research and standard engineering committees that meet once a week; general executive, manufacturing, administrative, finance, safety, employment and welfare, patent, sport and recreation and cost and efficiency committees meeting once a month, and the sales and salaries committees holding several sessions during the year. Members of the various committees attend sessions as individuals rather than in their official positions. The president and assistant general manager act as members ex-officio of all committees and all committees are governed by the general executive committee, consisting of the assistant general manager, sales manager and the chairmen of the engineering, manufacturing and finance committees. The committee of manufacturing is divided into two divisions, one on standard manufacturing and the other on new processes and development work. This committee is represented by the works manager as chairman, the president and assistant general manager. The works manager is also chairman of the sports and recreation and cost and efficiency committees. The chief engineer is at the head of the committees on engineering and patents. The administrative committee consists of the president and assistant general manager, secretary, treasurer and works manager.

Various manufacturing and welfare problems are taken up by the minor committees of superintendents and foremen, these being indicated by the following order of business as carried out at one of the committee meetings: new equipment, rearrangement of equipment, repairs of machines, electric lights and wiring, transportation of material, difficulty in adhering to engineering standards, recommendations in general, safety and entertainment. The superintendents' committee considers and passes on many matters relating to plant operations but is not given authority to overrule action taken by other committees. If that committee decides that something should be done that would change the ruling of another committee the matter is referred to the committee that made the ruling. The superintendents' committee does not pass on matters of major importance, but refers them to the executive or the manufacturing committee. To aid in good fellowship and in keeping the members of the organization in close touch, the company gives a dinner for its department heads every few weeks and the heads of each shift have a dinner once a month, the greater part of the expense of which is borne by the company.

An interesting feature of the welfare work of the company is the giving of moving picture entertainments in an auditorium in the factory. Two performances in which educational and entertaining films are shown are given each day during the hour before the afternoon and night shifts go to work. During the entertainment a musical program is rendered on a phonograph and smoking is permitted. That the moving picture shows are appreciated is indicated by the fact that they are largely attended and one of the effects of advantage to the company is that the men are seldom late for work. The three working shifts start at 6.30 a. m. and 2.30 and 10.30 p. m. The men on these shifts rotate backward each week in the time of starting to work, so that all are on the same basis in respect to working hours. The welfare department investigates garnishees of employees' wages and all cases of men who get behind in the payment of bills and makes efforts to keep the men out of the hands of loan sharks. Cases of sickness are investigated to see if the men are provided with proper clothing and medical attention. Advances of money, if needed, are made to employees when they or members of their families are sick. In connection with its welfare work the company has organized a baseball team and a bowling league among the employees.

A marked improvement in conditions has resulted from the maintenance of a hospital with trained nurses on duty 24 hr. a day and calls by the physician twice a day and oftener if needed. Employees are urged to go to the hospital for care of any injury, however small. With the establishment of the hospital department it is stated that the reports of accidents have been doubled, the number of cases requiring treatment by a physician have been reduced to less than one-third and the number that come under the state compensation law have been reduced to one-tenth of their former members.

New Iron and Steel Works Construction

Open-Hearth Steel Capacity Now Building 4,515,000 Tons a Year—That Completed Last Year Represented 4,205,000 Tons

IN new work initiated or planned, representing additions to steel-making capacity and blast furnaces in the United States, the year 1916 exceeded all previous records. It also reached a new high figure in the amount of new open-hearth capacity completed and put in operation within the year.

The new steel-making capacity provided during 1916 is nearly three times as large as that finished in 1915, as reported in our review a year ago. The present summary shows 103 open-hearth furnaces completed in 1916, with an annual capacity of 4,205,000 gross tons, while in 1915 the total completed was only 29, with an annual capacity of 1,405,000 tons.

Newly Added Open-Hearth Furnaces

The additions to open-hearth capacity in 1916 were the following: Three 75-ton furnaces of the Lackawanna Steel Company, Buffalo, N. Y.; four 100-ton furnaces of the Brier Hill Steel Company, Youngstown, Ohio; eight 80-ton furnaces of the Inland Steel Company, Chicago; two 60-ton furnaces of the Whitaker-Glessner Company, Wheeling, W. Va.; one 85 and one 100-ton furnace of the Allegheny Steel Company, Brackenridge, Pa.; three 100-ton furnaces of the Youngstown Sheet & Tube Company, Youngstown, Ohio; four 60-ton furnaces of the Pittsburgh Steel Company, Monessen, Pa.; one 100-ton furnace of the Wickwire Steel Company, Buffalo, N. Y.; six 80-ton furnaces of the United Alloy Steel Corporation, Canton, Ohio; three 80-ton furnaces of the Cambria Steel Company, Johnstown, Pa.; six 75-ton furnaces of Worth Brothers Company, Coatesville, Pa.; eight 75-ton furnaces of Corrigan, McKinney & Co., Cleveland, Ohio; four 75-ton furnaces of the Lukens Iron & Steel Company, Coatesville, Pa.; four 50-ton furnaces of the American Iron & Steel Mfg. Company, Lebanon, Pa.; four 50-ton furnaces of the Central Steel Company, Massillon, Ohio; two 50-ton furnaces, besides the enlargement of three 30-ton furnaces to 50 tons capacity, of the Pacific Coast Steel Company, San Francisco, Cal.; two 40-ton furnaces of the American Steel Foundries, Sharon, Pa.; one 50-ton furnace of the C. Pardee Works, Perth Amboy, N. J.; two 75-ton furnaces of the Keystone Steel & Wire Company, Peoria, Ill.; two 30-ton furnaces of the Standard Seamless Tube Company, Pittsburgh; two 75-ton furnaces of the Standard Steel Works Company, Burnham, Pa.; and four 60-ton furnaces of the Bethlehem Steel Corporation at its Lehigh plant, besides smaller furnaces at various minor steel-making and steel-casting plants. In 1916 the United States Steel Corporation completed nine 75-ton open-hearth furnaces at its various plants, as well as the addition of two 25-ton converters at the duplexing plant of the American Steel & Wire Company at Donora, Pa. The nine furnaces were as follows: Three 75-ton furnaces at the Ohio works of the Carnegie Steel Company; two 75-ton furnaces at the Clairton works, and three 75-ton at the Farrell works of the same company, besides the completion of one furnace at the plant of the National Tube Company, Lorain, Ohio. The total additions of the year are therefore summarized in the accompanying table.

Furnaces under construction, many of which will be completed in 1917, number 72, which compares with 91 a year ago. Although the number this year is less, the total estimated annual capacity is larger, or 4,515,000 tons for the 72 furnaces, as compared with 4,265,000 tons for the 91 furnaces due to the fact that several large duplexing plants with new converters are now coming forward.

In the list of furnaces under construction and projected, the Steel Corporation is represented by six 75-ton furnaces at the plant of the National Tube Company, Lorain, Ohio; by a duplexing plant at the Indiana Steel Company, Gary, Ind. consisting of two 100-ton tilting open-hearth furnaces and two 25-ton Bessemer converters; by a new duplexing plant at the South works of the Illinois Steel Company, South Chicago, consisting of two 100-ton open-hearth furnaces, and two 25-ton Bessemer converters, and by one 100-ton tilting open-hearth furnace at the same plant to supply hot metal to the two new 20-ton Heroult electric furnaces.

New Open-Hearth Furnaces Completed in 1916

	Number Furnaces	Annual Capacity, Gross Tons
Independent companies	94	3,540,000
United States Steel Corporation	9	*665,000
Total	103	4,205,000

*Includes 240,000 tons increase in capacity of open-hearth plant at Donora, Pa., by adding two 25-ton converters to work duplexing.

In this list the Bethlehem Steel Corporation is credited with the installation at its Saucon plant at South Bethlehem, Pa., of two 200-ton tilting open-hearth furnaces, a 25-ton Bessemer converter and a new 1300-ton mixer with all auxiliary equipment; with one 200-ton tilting furnace and a 20-ton converter at its Steelton plant, Steelton, Pa., and with a new duplexing unit at the Maryland steel plant, Sparrows Point, Md., consisting of four 200-ton tilting furnaces, four 30-ton converters and two 1300-ton and one 250-ton hot metal mixers.

New installations at other plants of some of the principal companies are as follows: one 75-ton furnace of the Lackawanna Steel Company, Buffalo, N. Y.; two 80-ton furnaces of the Inland Steel Company, Chicago; one 60-ton furnace of the Whitaker-Glessner Company, Wheeling, W. Va.; two 100-ton furnaces of the Pittsburgh Crucible Steel Company, Midland, Pa.; one 30-ton furnace of the Allegheny Steel Company, Brackenridge, Pa.; three 100-ton furnaces of the Youngstown Sheet & Tube Company, Youngstown, Ohio; three 60-ton furnaces of the Wickwire Steel Company, Buffalo, N. Y.; four 80-ton furnaces of the United Alloy Steel Corporation, Canton, Ohio; one 75-ton furnace of the Youngstown Iron & Steel Company, Youngstown, Ohio; one 85-ton furnace of the West Penn Steel Company, Brackenridge, Pa.; four 75-ton furnaces of Corrigan, McKinney & Co., Cleveland, Ohio; four 100-ton furnaces of the Trumbull Steel Company, Warren, Ohio; three 50-ton furnaces of the Canton Sheet Steel Company, Canton, Ohio; seven 100-ton furnaces of the Donner Steel Company, Buffalo, N. Y.; two 75-ton furnaces of the Lukens Iron & Steel Company, Coatesville, Pa.; two 15-ton furnaces of the Carpenter Steel Company, Reading, Pa.; two 40-ton furnaces of American Steel Foundries, Sharon, Pa.;

three 75-ton furnaces of the Ashland Iron & Mining Company, Ashland, Ky.; four 75-ton furnaces of the Cromwell Steel Company, Lorain, Ohio; two 60-ton furnaces of the Interstate Iron & Steel Company, Chicago, besides several furnaces at smaller plants. The prospective increased capacity thus stands as follows:

New Open-Hearth Furnaces Under Construction

	Number Furnaces	Annual Capacity, Gross Tons
Independent companies	61	*3,395,000
United States Steel Corporation	11	†1,120,000
Total	72	4,515,000

*Includes product of duplexing plants, with total of 7 converters at Sparrows Point, South Bethlehem and Steelton.
†Includes product of duplexing plants, with total of 4 converters at South Chicago, Ill., and Gary, Ind.

In addition to the foregoing the Mark Mfg. Company is constructing at Indiana Harbor, Ind., a Bessemer plant consisting of two 20-ton converters and the new Gary Tube Company at Gary, Ind., is building a Bessemer plant containing two 12-ton converters. These two additions will represent 500,000 tons of Bessemer steel per year, so that the total of new steel capacity under construction or projected is 5,015,000 tons a year.

New Blast Furnace Construction

New blast furnaces projected last year, a good many of which are well under way, exceed in number those for any previous year. Our list shows a total of 25, as compared with only 10 one year ago. The 25 furnaces represent a total capacity of about 4,175,000 tons of pig iron per year. In 1916 five blast furnaces were completed, adding about 800,000 tons of pig iron a year to the capacity of the country. The following table gives details of the new blast furnaces completed in 1916 or at present under construction:

Company	Completed 1916	Under Construction 1917
Inland Steel Company	..	1
Whitaker-Glessner Company	..	1
Republic Iron & Steel Company	..	1
Worth Brothers Company	..	1
Cambria Steel Company	1	2
Corrigan, McKinney & Co.	3	1
United Furnace Company	1	..
Sloss-Sheffield Iron & Steel Company	..	1
Ford Motor Company	..	2
Bethlehem Steel Company:		
Sparrows Point	..	4
Steelton Plant	..	3
United States Steel Corporation:		
Indiana Steel Company	..	4
Gary Tube Company	..	4
Donner Steel Company	..	1
Total	5	25

In addition to the above, the Youngstown Sheet & Tube Company, Yongstown, Ohio, projected a new furnace in 1916, but has not gone forward with it. It is stated that the project of the Detroit Iron & Steel Company, Detroit, Mich., to build a third furnace is held up, as is also that of the Iroquois Iron Company for an additional furnace. The Pulaski Iron Company, Pulaski City, Va., dismantled its stack and replaced it with a new one with all modern improvements, which was recently put in blast.

Bethlehem Steel Corporation

The Bethlehem Steel Corporation has under way at present a program for additions and extensions which involves the expenditure of something over $100,000,000 in the next two or three years. This expenditure will be made to a very large degree at the various steel plants of the company, but also includes a considerable program at its coal and iron mines and shipyards.

As of Jan. 1, 1917, the Bethlehem Steel Company acquired and assumed full charge of the American Iron & Steel Mfg. Company's plants at Lebanon and Reading, Pa., and also the coke ovens and blast furnaces of the Lackawanna Iron & Steel Company at Lebanon, both owned and leased. No definite construction program has been developed for these two companies as yet.

Construction work completed during 1916 and now in progress in various plants is as follows:

Lehigh Plant

In the blast-furnace department a new two-strand Uehling casting machine was put in service early in the year. The new blast furnace B, with its Bethlehem gas blowing engines, is nearly completed.

In the open-hearth No. 1 department complete equipment for operating this plant on pulverized fuel has been contracted for. In the open-hearth No. 3 a fifth open-hearth furnace was started in the year, together with its mechanical gas producers and other auxiliaries, including mold-heating apparatus.

One 10-ton Girod electric furnace was put in operation.

In the merchant mills new equipment was provided in the way of additional heat-treating and cold-drawing capacity, which included extensions to the building, several cranes, shaft turning machines, straightening machines, cold saws, etc. At present an additional soaking pit furnace and gas producers are being constructed.

In the forge department a new 2000-ton hydraulic forging press, complete with its furnaces, motor-driven pressure pumps and other auxiliaries, is just going into service.

For the general treatment department a large building was erected, containing full equipment of vertical and horizontal furnaces for heat treatment of moderate sized forgings of all descriptions.

A machine shop, No. 5, which will be 180 x 700 ft., has been started and will be pushed to completion in a few months. It is designed entirely for rough and finished machining of large gun forgings and will be equipped for 12-in., 14-in., 16-in. and 18-in. guns. A large building of about the same area is being erected for the heat treatment of these forgings, and this will be equipped with large car-bottom furnaces for annealing and vertical furnaces and oil tank for oil tempering. In the high part of this building, which will be used for oil tempering of the forgings, a gun shrinkage and assembling plant will also be installed. This complete layout for large guns will involve the expenditure of $5,000,000.

In the steam department a new boiler house of 3600 hp. was completed. In addition to the three 3000-kw. a.c. generators, which were completed in 1915, a new unit has been put in operation and three more are practically completed. These generators are driven by the twin tandem compound Bethlehem gas engines. The whole installation is in a handsome new power house.

Saucon Plant, South Bethlehem

Considerable extensions are in progress at this plant, including a 25-ton Bessemer vessel, two 200-ton tilting open-hearth furnaces, a new 1300-ton mixer, with all auxiliaries such as stockyard, mold yard, gas producers, etc. This plant will be in service about the middle of 1917.

The new 18-in. mill is complete and will go into service in the next few weeks. The 12-in. mill is under way and will be running about the middle of the year. In addition, a second mill for the rolling of special Bethlehem shapes is under way, with all its auxiliary equipment. This mill is 42 in.; it will be completed late in 1917.

Redington and New Castle Plants

At Redington, which is about four miles from Bethlehem, the proving grounds have been greatly in-

proved. The shop, designed primarily for the manufacture of projectile fuses, is in operation, including the plant for loading fuses and making of powder pellets, etc., for shrapnel. A considerable extension has been made for assembling complete rounds, and this plant as a whole to-day has a capacity for assembling and loading complete 1,000,000 rounds of field ammunition per month. A very complete system of fire protection has been installed.

The plant at New Castle, Del., is now fully equipped for the casting and pressing of high explosive charges for all sizes of shell.

Limestone Quarries

More than $1,000,000 is being expended to increase the capacity of the dolomite quarry at Bethlehem and the calcite quarries at McAfee. This amount will go into steam shovel equipment, crushing plant, telpherage system, electric power plants, dwellings, etc., to about double the output of these quarries.

Constable Hook

At Constable Hook, N. J., the iron-ore unloading plant has been entirely completed and will be put in service very shortly. It is designed to unload all foreign ore received for the Bethlehem Steel Company blast furnaces.

Titusville Plant

At the Titusville, Pa., plant, which is designed for forging and machining the various sizes of forgings, extensions have been made in the way of a new office, boilers, one 2000-ton hydraulic press, two car-bottom annealing furnaces and necessary cranes, etc. In the machine shop the building has been extended and a number of machine tools added for machining forgings.

Steelton Plant

Three additional 500-ton blast furnaces are under way and it is expected that they will all be in blast in 1917. The auxiliaries for these furnaces include a new ore bridge and seven Bethlehem gas-driven blowing engines. To supply additional coke 60 Koppers ovens have been contracted for, including considerable extension to the by-product plant.

To the steel-making department are being added a 20-ton converter and one 200-ton tilting furnace. Waste-heat boilers will be installed at all the three large tilting furnaces.

An additional pit furnace is being built at the 44-in. blooming mill and complete studies are being made of a new 40-in. blooming mill with 35-in. roughing and 24-in. finishing stands, which new mills will eliminate the old blooming and slabbing mills now in service.

In the forge shop, one 300-ton, one 500-ton, one 1000-ton and one 1200-ton forging presses are being installed, together with auxiliary equipment of annealing furnaces, overhead cranes, etc. A 300-ft. extension is being constructed to the machine shop building and a large number of machine tools purchased, principally for machining forgings.

The steel foundry fireproof pattern storage building is being doubled in capacity and studies are being made for considerable extension to the various divisions of the steel foundry so as to increase the output by about 50 per cent.

The frog and switch department is being equipped with a number of modern grinding and planing machines of special design.

The power station is being extended to include the installation of three 3000-kw. generators, which will be driven by Bethlehem gas engines.

Considerable expenditures are being made for broad-gage locomotives, steel coke cars and locomotive cranes.

Lebanon Plant

A very considerable extension is under way at the concentrating and sintering plants for Cornwall ores and when these are completed this plant will have double the present capacity or about 1,000,000 tons per year.

Maryland Steel Plant, Sparrows Point, Md.

A large acreage adjoining the present plant has been purchased and a number of dwellings for workmen have been completed or will be completed in the next few months. In connection with the town, a new sewerage system is being installed by the company.

Four 500-ton blast furnaces have been contracted for and all equipment, including new casting machine, gas washers, etc., is under way. To supply coke for these furnaces, four batteries of 60 Koppers coke ovens have been contracted for, with by-product plant. the ovens will be 13¼ tons capacity. An elaborate system for coal unloading, handling, crushing, mixing, etc., will be completed in the next year or 18 months. The ore dock serving the blast furnace plant will be considerably extended and additional bridges and unloaders purchased. The 30-ft. channel leading from the main Baltimore channel will be deepened to 35 ft. to permit a 17,000-ton ore boat to get all the way up to the dock.

Thirteen Bethlehem gas-driven blowing engines will be installed for blowing the blast furnaces. These will be 47 x 84 x 60 in. In the same power house will be installed eight 47 x 60 in. Bethlehem twin tandem gas engines driving 4000-kw. generators.

A new duplexing plant will be built consisting of four 30-ton converters and four 200-ton tilting furnaces, the latter equipped with waste-heat boilers. Two 1300-ton and one 250-ton hot metal mixers will be installed in connection with this plant.

The following mills will be added: 40-in. blooming with 24-in. and 18-in. billet mill for sheet bars and billets and 36-in. slabbing mill to slab for the three plate mills, which will consist of a 110-in. plate mill, a 60-in. universal reversing plate mill and a 166-in. plate mill. There will also be three new merchant bar and rod mills of semi-continuous type. All the mills will be motor-driven. The first twelve tin-plate mills are at present well under way and twelve more will be added as soon as practicable.

The above program requires considerable additions to water stations, transportation department and other general departments. Included is an extension to the iron foundry which will about double the capacity.

Shipbuilding Plants

At the Sparrows Point shipyard a new machine shop, 175 x 420 ft., including equipment of new machine tools, has been put in service, as well as a new steel and brick fabricating shop with cranes, hydraulic flanging machines, etc. A blacksmith shop, 75 x 325 ft., is just being started for these yards.

Extensions will also be made to the boiler, tin and pipe shops and a new copper shop will be built. A new 20,000-ton floating drydock to accommodate vessels up to 600 ft. in length by 80-ft. beam is now well under construction. Necessary dredging and concrete bulkhead have been contracted for. In these yards are being built four 11,000-ton ore boats and one 17,000-ton ore boat to transport the company's ores from the Chilean and Cuban mines. All are well along.

At the Fore River Shipbuilding Corporation's yard the new ship tool shop was completed in 1916. This building, which is 185 x 775 ft., was constructed for the handling, fabricating, assembling and riveting of structural material for ships. It is of steel, brick and concrete, with a maximum amount of steel sash and natural lighting, and is practically fireproof. A new joiner and pattern shop, together with a lumber storage building, was also completed. Other main improvements completed during the year include a new hospital building, club house and athletic field, addi-

tional machines for sheet metal shop, two locomotive cranes, 10,000-lb. steam hammer for blacksmith shop, extensions to three runway slips, new slip with steel overhead structure and two traveling cranes. Construction work in progress includes a new sea wall 500 ft. in length and dredging for 25-ft. berth for the mooring of battleships and other large vessels; concrete slips, towers, crane runways, etc., for submarine slips; three 10-ton bridge cranes for submarine slips; also a galvanizing plant. It is intended to erect for these yards a new berth to build the largest capital ships for the United States Navy.

Union Iron Works Company: At the Potrero plant, San Francisco, the main improvements include an annex to the joiner shop and new steel building, slip No. 1. Main improvements in construction include a two-story and basement reinforced concrete hospital, a new brass and iron foundry and a speed launch. The Alameda, Cal., branch of the Union Iron Works Company, formerly the United Engineering Works, was acquired in February, 1916. The plant originally consisted of about 25 acres of land, having a water front of 1200 ft. across the bay from the Potrero plant. At the time of its purchase the main equipment was two marine trackways, the larger of which could drydock vessels 400 ft. in length and 3500 tons in weight. A machine shop, joiner shop, plate shop and auxiliary departments completed the plant. On being acquired by Bethlehem an extensive construction program was started, which included the building of four ways served by five 20-ton tower cranes, operating on steel runways; a new plate shop, mold loft, angle smith shop—all with full machine-tool equipment; power house, locomotive cranes, railroad tracks and a general strengthening and enlarging of the auxiliary departments.

Hunters Point, San Francisco: At the plant during the year about four acres of land was reclaimed. Construction in progress includes the building of a wooden floating drydock, 100 x 450 ft., and a concrete graving dock, 153 x 1020 ft. It is intended to erect for these yards a new berth to build the largest capital ships for the United States Navy.

At the Harlan & Hollingsworth Corporation's shipyard, Wilmington, Del., general improvements and extensions have been made to the various ways, including a 120-ton stationary steel tower crane and two additional tower cranes for No. 5 ways, and additional equipment to the boiler shop and other departments. In the car department, a new building was erected for a car plate storage and template shop.

The plant of the Samuel L. Moore & Sons Corporation, Elizabeth, N. J., was very considerably rebuilt, a new large machine shop erected and equipped with modern tools, five-story pattern shop and storage building and new blacksmith shop. This program will be complete in a few months and the plant will then be able to construct small harbor craft, such as tugboats, barges, canal boats and carfloats, as well as merchant vessels up to 350 ft. in length.

Chilean and Cuban Iron Mines

In addition to the considerable sum of money already expended by the Bethlehem-Chile Iron Mines Company, at Tofo, Chile, it is intended in the next year or two to spend $2,000,000 to $3,000,000 to bring the total output of these mines up to 1,500,000 tons of ore per year.

The present plan of extension at the Cuban iron mines, Mayari division, is to double the present capacity all along the line, building up the output to 1,000,000 tons of ore per year.

Construction work in progress at the Daiquiri division, Cuban mines, includes a 30,000-ton ore storage plant and cantilever bridge.

At the mines of the Penn-Mary Coal Company, Heilwood, Pa., extensions and improvements are being made which will about double the present output.

Midvale Steel & Ordnance Company

At the plants of the Cambria Steel Company, Johnstown, Pa., acquired by the Midvale Steel & Ordnance Company in the early part of 1916, there has been an active campaign of new construction. A 500-ton blast furnace at the Franklin works, which is No. 9, was completed in 85 days. Foundation work started March 12 and the furnace was blown in June 5. In November two additional 500-ton furnaces were authorized and one of these will be completed in the spring of 1917. Three horizontal cross-compound steam blowing engines have been authorized for the Nos. 1 to 4 blast furnaces. The pig-casting plant was extended to cover a 1300-ton hot metal receiver, with 75-ton four-girder ladle crane and auxiliary equipment. Three 80-ton open-hearth furnaces have been added at the Franklin works in the past year. At the coke plant 100 by-product ovens on which construction was begun in 1915 were operated and an additional battery of 120 ovens was completed. Increased power requirements at the Franklin works were met by the installation of a 6000-kw. steam turbine unit and a second of equal size is under construction. The concentration of steel wheel manufacture at Johnstown is under way. A complete Slick wheel unit is planned, a wheel plant with a capacity of 500 wheels per day being now under construction and a tire plant with a daily capacity of 500 tires. In addition a built wheel plant is being provided and an axle plant with capacity of 11,000 axles per month. Changes and additions to the Franklin 40-in. blooming mill were made so as to furnish steel for the rolled steel wheel and tire plants. An additional soaking pit furnace was installed and extensions made to the slab mill furnace house. A preheating soaking pit furnace was provided at the blooming mill, to be heated by coke oven gas.

At the Worth Brothers Company plant, Coatesville, Pa., a 500-ton blast furnace has been under construction in the past year, together with gas blowing engines, extension to ore yard, ore bins, etc. It will be completed about March 1. An extension to open-hearth building No. 2 was made and six 75-ton furnaces were completed in 1916. Various minor improvements were made to the open-hearth plant. Extensions to the electric power plant include two 750-kw. turbo generators. A new 40-in. blooming mill, with engine, boilers and boiler house, pits, cranes, etc., was built. Other new construction includes a flange department, shell forging department with furnaces, presses, draw benches, etc., also a new machine shop, a blacksmith shop with cranes and machinery and a new storage yard. The yard equipment was considerably increased.

At the steel works of the Midvale Steel Company, Nicetown, Pa., two waste heat boilers for Nos. 7 and 9 open-hearth furnaces were provided, and additions were made to the crane equipment, to machine shops and heat-treating department. In the rolling mills and shops considerable additions were made to equipment, particularly in heating furnaces. A brick and steel extension 60 x 550 ft. was made to the No. 6 shop, with full equipment of machine tools. Two 500-ton presses were added. No. 7 machine shop was built, 220 x 619 ft., and fully equipped. An extension was made to the rolled wheel plant building, consisting of a steel mill building 114 x 116 ft. A new main office building which will cost $200,000 is under construction, and a modern laboratory building, to cost $80,000.

At the Wilmington Steel Company plant, Wilmington, Del., there was a complete rehabilitation of five open-hearth furnaces, blooming mill, rolling mills, etc.

New mill offices and a restaurant for the use of employees were constructed.

Youngstown Sheet & Tube Company

The extension program now approaching completion by the Youngstown Sheet & Tube Company, Youngstown, Ohio, was originally adopted early in 1915 and called for an appropriation of $5,000,000. It then included only the construction of a by-product coke plant, the erection of bar mills, and some minor changes in the plant organization. As the program was carried out, however, it was rapidly enlarged, until at the close of 1916 approximately $12,000,000 had been expended and a considerable amount of construction work is still in progress. The extensions and improvements completed during 1916 will increase the output of the works approximately 30 per cent. Among the more important units built under this program and now in service are:

By-product coke plant with 204 Koppers ovens, with thoroughly modern equipment and a rated capacity of 825,000 tons of coke per year.

Benzol and by-product recovery plants, erected by the Semet-Solvay Company, with a capacity sufficient for handling the gas produced by the by-product ovens.

One 18-in. skelp mill with necessary auxiliaries and equipment.

Three 100-ton open-hearth furnaces, bringing the number of furnaces in service to nine.

An addition doubling the capacity of the open-hearth stock house with necessary crane and other equipment.

A new power station at the rod and wire department. This station is equipped with four 768-hp. Babcock & Wilcox boilers, Riley stokers, Helander condenser and three 1500-kw. direct-current geared turbo generators.

New works office building, with 57,800 sq. ft. floor space, designed to accommodate the executive and clerical force directly connected with the operating department. The general offices of the company, including the sales department, occupy the third floor of the Stambaugh Building in Youngstown. The new office building is equipped with a complete modern restaurant with a capacity of 350 noon meals per day. It is operated on a cost basis as a convenience to the clerical and executive forces of the works.

A new laboratory building, with a floor space of 7140 sq. ft. This building is divided into four main laboratories, each serving one of the general divisions of the works. The routine laboratory work for the coke plant, however, is not done in this building, a special laboratory of adequate capacity having been erected in the coke plant itself for routine work. Quarters for chemical, metallurgical and inspection departments are provided in this building.

An emergency hospital, located at the main north gate of the works, equipped with every facility for medical, surgical and welfare work.

In addition to the above, an ore bridge with extensive improvements to the facilities for handling stock has been installed at the furnaces of the Andrews & Hitchcock Iron Company at Hubbard, Ohio, which was acquired by the Youngstown Sheet & Tube Company early in the year.

Uncompleted Work of 1916 Program

Work on the original 1916 program remaining uncompleted consists of one 9-in. Morgan continuous bar mill and one 12-in. Morgan continuous bar mill. The 9-in. mill has a continuous roughing train of six stands and a continuous finishing mill of six stands and one Edwards sizing mill. The roughing mill will be driven by a 37 x 48-in. Nordberg uniflow engine. Two stands of finishing rolls will be driven by a 700-hp. direct-current Crocker-Wheeler motor. Four stands of finishing rolls will be driven by two 600-hp. direct-current Crocker-Wheeler motors. The sizing mill will be driven by a 100-hp. direct-current Crocker-Wheeler motor. The 12-in. mill will have a continuous roughing mill of five trains and a finishing mill of two trains, each of two stands of staggered duo type. The capacity of this mill under normal conditions should be 10,000 tons of average sections per month. This mill will be driven by a 44 x 50-in. Nordberg uniflow engine. The 9-in. mill building is 90 x 1150 ft. The 12-in. mill building is 100 x 401 ft. They are among the largest mill buildings in America and are now fully completed.

The 9 and 12 in. mills are served by two 15-ton Cleveland cranes, and one 15-ton Cleveland crane has been installed in the billet yard, with another of the same size in the warehouse.

The 1300-ton mixer plant begun during 1916 will not be completed for some time. This mixer plant will be used exclusively by the open-hearth department, leaving the present plant entirely at the service of the Bessemer department.

Extension Program for 1917

The extension program for 1917 has been already begun by the starting of work on three additional open-hearth furnaces of 100 tons capacity which are expected to go into service the first of April. In addition to these furnaces, four additional pit furnaces are being constructed, two of which are for use in the open-hearth and two in the Bessemer department.

A new building equipped for stripping ingots will be erected, with sufficient capacity to take care of all the open-hearth and Bessemer production. Considerable additions are being made to the finishing capacity of the tube mills, mainly in the extension of threading floor facilities.

Plans for a new locomotive repair shop, equipped with cranes and other necessary machinery, are being prepared in the engineering department. This building will be erected during the year.

A storage house to contain machinery parts and other material is in course of erection. This building will be 300 x 400 ft.

A new cinder yard, with equipment of cranes and other necessary machinery, is under course of construction.

The cost of the above items, together with other minor changes and improvements authorized for this year, is estimated at approximately $4,000,000.

An additional blast furnace of 500 tons capacity has been authorized, but work on this has not yet begun.

Central Iron & Steel Company

During 1916 the receivers of this company reconstructed the boiler plant of the 126-in. three-high plate mill in order to burn a low grade of anthracite coal and to provide an efficient ash-handling system which also takes care of the ashes from an adjoining battery of gas producers. Similar improvements have been made at the open-hearth boiler house. To facilitate the disposal of refuse materials, desirable dumping grounds were acquired, located about one-half mile from the plant. Tracks and necessary equipment, including a 30-ton locomotive crane, have been provided for the efficient handling of slag and ashes on the dump. The 72-in. plate mill that had been idle a couple of years was put in operation in April, 1916. The universal mill has received new housings of improved design, and a 28 x 48 x 60-in. engine has been purchased for the 89-in. three-high plate mill. All the mill buildings have been extensively improved and considerable work carried out for the safety and comfort of the employees. For the electrical department a 500-kw. rotary converter has been purchased.

An additional open-hearth furnace with a 41-ft. 6-in. x 15-ft. hearth, 5 ft. 6 in. deep from the sill line to the pan plates, is now under construction. To accommodate this furnace the open-hearth building is being extended 80 ft. on the charging side and 180 ft. on the pit side, and the open-hearth gas producer building is being extended 96 ft. The existing open-hearth plant is undergoing considerable changes to facilitate transportation, and new auxiliary shops and brick sheds are being built. The blast-furnace plant, which has been idle for a few years, is being rebuilt for increased capacity. The first furnace is expected to be blown in about

March, 1917. The starting of the blast-furnace plant involves the construction on short notice of about 1200 ft. of reinforced concrete trestles 22 ft. high.

In 1917 the company plans to enlarge the four present open-hearth furnaces on lines similar to those of the furnace now under construction. A power plant, new pumping plant and various mill improvements are also contemplated.

Corrigan, McKinney & Co.

The company started up part of the open-hearth furnaces of its new steel plant at Cleveland, Ohio, in January, 1916, and during the early part of the year got the entire plant in operation. This consists of eight 75-ton open-hearth furnaces, a 40-in. blooming mill, 21-in. and 18-in. continuous sheet bar and billet mills and a 1000-ton hot metal mixer. Late in 1916 the company blew in a third blast furnace of 600 tons capacity per day and now has its fourth furnace practically completed. In connection with its blast furnaces it has built 204 Koppers by-product coke ovens, one-half of which are now in operation. A benzol plant is being erected.

For 1917 the company expects to complete 4 additional 75-ton open-hearth furnaces now under construction, two of which are expected to be finished in April.

Trumbull Steel Company

This company will soon begin the erection of an open-hearth steel plant at Warren, Ohio, to manufacture steel for its own requirements. The number and size of the open-hearth furnaces has not been announced. The equipment will include a 36-in. blooming mill and an 18-in. Morgan sheet bar mill.

In 1916 the company completed the installation of four sheet mills, two tin mills and two jobbing mills, making 32 mills in all. It has under construction at present a hot and cold rolled strip plant which will be ready for operation probably in July.

Mark Mfg. Company

The above company, which manufactures wrought pipe and oil well casing, awarded contracts in May, 1916, for the building of a Bessemer steel plant at Indiana Harbor, Ind. There will be two Bessemer converters of 15 tons capacity each; a 1000-ton mixer; 35-in. blooming mill with soaking pits, tables, shears, etc.; 30-in. two-high billet mill designed to roll skelp from slabs; 10-in. skelp mill comprising a Morgan continuous roughing, edging and finishing mill; pipe mills comprising one butt and one lap weld mill. The electrical power plant will develop 10,000 kw. and all mills and equipment will be electrically driven. The plant is expected to be in operation in the early part of 1917. Pig iron will be obtained from the Iroquois blast furnaces, in which the Mark Mfg. Company has an interest.

United Alloy Steel Corporation

The United Alloy Steel Corporation, Canton, Ohio, completed in 1916 a new steel plant known as its plant B. This consists of six 75-ton open-hearth furnaces, a 300-ton hot metal mixer, a Mackintosh, Hemphill & Co. 35-in. reversing blooming mill, and a Morgan 18-in. continuous sheet bar and billet mill. Four additional 75-ton open-hearth furnaces are being built, which will be ready for operation about April. Electrical drive is provided throughout. The blooming mill is driven by a 15,000-hp. Westinghouse reversing motor and the sheet bar and billet mill by a 4200-hp. Westinghouse synchronous motor. Other extensions completed during the year include a Morgan continuous 8-in. bar mill, located in a building between the old and the new plant, and in the old plant a 26-in. Lamberton billet and bar mill and a 15-ton Heroult furnace. A new heat treating plant is being built which will be placed in operation shortly. Further extensions will be made this year, plans for which have not been definitely decided upon, but they will include some finishing mills and possibly a forge shop for making large railroad forgings of alloy steel.

The United Furnace Company, controlled by the United Alloy Steel Corporation and Pickands, Mather & Co. interests, started up in November its blast furnace on a site adjoining plant B, for which it furnishes molten metal. This furnace has a daily capacity of about 500 tons and in connection with it are 47 Koppers by-product coke ovens and a benzol plant.

Interstate Iron & Steel Company

At the South Chicago, Ill., steel works of this company, which have just been taken over in connection with the purchase of the Grand Crossing Tack Company, work will begin early in 1917 on two additional 60-ton open-hearth furnaces. This will give a total of four furnaces. The two new ones will probably be finished in April.

Colorado Fuel & Iron Company

The most important new construction undertaken at the Pueblo, Col., plant of the Colorado Fuel & Iron Company in 1916 was the work on a by-product coke plant of 120 ovens.

Jones & Laughlin Steel Company

The only extension to plants made by this company in 1916 was the building of two butt and two lap weld pipe furnaces at its Aliquippa, Pa., works. One butt and one lap weld furnace were completed in September and the other two were finished later. These four furnaces have a capacity of 8000 to 10,000 tons of butt and lap weld steel pipe per month. In order to provide plates for the pipe furnaces, some additions were made to existing plate mills in the Aliquippa works. There are some plans for large additions to the Aliquippa works to make new lines of product, but these are not likely to be taken up actively while the present abnormal demand for iron and steel exists. The company contemplates adding six 50-ton furnaces to its open-hearth plant on the South Side, Pittsburgh, providing construction work can be done quickly. The completion of these furnaces in 30 days was asked for, but the best time promised is 65 days, working night and day.

La Belle Iron Works

In September, 1915, the La Belle Iron Works placed an order with the H. Koppers Company for 94 by-product coke ovens to supply coke for its two blast furnaces at Steubenville, Ohio. These ovens are located on the property across the Ohio River from the blast furnaces and are about finished and will likely be making coke early in January, 1917. To take the coke over to the furnaces the company contracted with the American Bridge Company for a steel bridge across the Ohio River, requiring about 6000 tons of steel. This bridge is about half finished, and meanwhile the coke will be transported to the blast furnaces by other means. There were some small additions to finishing plants, but no large new work. The company contemplates one more open-hearth furnace, making a total of 12, but a definite decision has not been reached.

Brier Hill Steel Company

During 1916 this company completed the building of four 100-ton open-hearth furnaces at its open-hearth steel plant at Youngstown, Ohio, and also increased its

boiler capacity 25 per cent and made some minor extensions. The company is building 84 Koppers by-product coke ovens, which are expected to be ready in March, and which will supply coke to its Grace and Tod furnaces. It also established a restaurant for the convenience of employees, at which meals are furnished at absolute cost. This company has in mind plans for large extensions, perhaps to be started in 1917, but they are not yet fully matured. It is possible the company may take up some new lines of products.

Pittsburgh Steel Company

This company, which operates two blast furnaces, open-hearth steel works, rod, wire, wire nail and fence departments at Monessen, Pa., completed during the year four 60-ton open-hearth furnaces, the last one having been started about Nov. 1. It also made minor additions to storage capacity for scrap and pig iron, to take care of these additional furnaces. The whole plant was operated to utmost capacity during the entire year, as were the hoop and band mills at Glassport, Pa.

Crucible Steel Company of America

Additions made by this company to its various plants in the Pittsburgh and Eastern districts in 1916 were probably larger than in any one year since the company was organized. The additions and improvements made to its different plants were as follows:

Crescent Works: A new boiler house is being completed, in which new boilers are being installed. Also a new office building and laboratory are being erected. The company has in contemplation the construction of a dock at the Allegheny River waterfront to be erected during the coming summer for the purpose of handling coal direct from the barges. A complete modern emergency hospital is also being erected at this plant.

Park Works: A new emergency hospital is being built with all up-to-date appliances. Also, the construction of a new dock is planned for next summer, made necessary because the great weight of the Junction railroad cars and locomotives passing over it have destroyed it. The company is also planning to construct at the Park works a new open-hearth department, to consist of four stationary open-hearth furnaces, one tilting and one electric furnace, with all modern appliances for economically handling the output. This new plant will be erected on the site of the old puddle mill building, which has been out of use for some years.

La Belle Works: Plans have recently been made for the construction of a new dock at this plant to more economically handle coal from the river; also a new central boiler station to take the place of the separated boilers located throughout the plant. The construction of this boiler house will be in the nature of a new departure, the boilers to be built 20 ft. from the level of the ground so that the space beneath them can be used for other purposes. The coal used will be handled entirely mechanically, and the ashes will be taken out in the same manner, so that it is not necessary for the boilers to be built on the ground.

Singer Works: A central boiler house is now under construction at this plant, the boilers now being on the ground awaiting installation. This new unit will enable the company to eliminate the other old boilers now producing steam at this plant.

Atha Works: The present open-hearth building is being enlarged so as to contain an additional 50-ton tilting open-hearth furnace in addition to a new 3-ton Heroult electric furnace. Also a new hammer building is being erected to cover the installation of an 8-ton Sellers steam hammer, soon to be delivered. Along the public street a high brick wall has been built, connected with which has been erected an emergency hospital, time office, garage and stable. The wires carrying electric power, heretofore suspended from poles, will shortly be carried through concrete conduits throughout the plant.

Sanderson Works: During the past year a plot of ground has been purchased in the suburbs of Syracuse upon which have been erected buildings for the installation of an additional cold-drawing and wire mill for the Sanderson plant. To supply the mill with rods, a bar mill is being installed in one of the buildings. The old warehouse has been torn down and a steel building to replace it is now nearing completion.

Crucible Fuel Company

During the past year a modern steel tipple for handling coal from one of the shafts into railroad cars for distribution to some of the company's mills east and north has been completed, and it is expected that during the coming spring after the main entry leading to this shaft is completed coal will be regularly shipped by rail. This is in addition to the shaft now used for shipping coal by water to the mills at Pittsburgh and Midland, Pa. In order to accommodate the increasing number of employees at this plant the company is adding some 30 additional houses, so that the development there will then contain 183 houses, ample to take care of a sufficient number of employees to handle 60,000 tons of coal per month from the mines.

Pittsburgh Crucible Steel Company

This company, which is a subsidiary of the Crucible Steel Company of America, is adding to its plant at Midland, Pa., two 100-ton open-hearth furnaces, also the necessary extension of buildings and extension to the chipping shed and a new building for cold-rolling and heat-treating. These additions are now under way, the buildings being erected by the American Bridge Company. They should be finished by the middle of 1917. The company is also building a new iron foundry. Steel is already on the ground for this building, and it is expected to have the foundry in operation in the spring.

There is also being built a complete modern emergency hospital for the care of employees who may require prompt medical or surgical attention.

In the latter part of 1916 the company finished the construction of an extension to its blooming mill building, in which is housed the new billet mill. This is a 28-in. mill to take care of the increased output of open-hearth steel and to relieve the rolling pressure on the 40-in. blooming mill, now largely used to roll heavier sections. Owing to its scarcity, natural gas has been supplanted by producer gas and oil.

Donner Steel Company

In the extensions under way at the works of the Donner Steel Company, Buffalo, N. Y., bar mills and an 84-in. plate mill are included. A forge and axle plant are also under construction and coke ovens are to be added as soon as possible.

The present blast furnace is being changed to a 500-ton furnace and the construction of an additional 600-ton blast furnace is being rapidly pushed. Both of these will be equipped with the Slick patent distributing top.

A reinforced concrete dock, 1200 ft. long, with piles the average length of which is 52 ft., driven on 4-ft. centers to rock, is under construction. Its top will be of reinforced concrete 24 in. thick. The ore and limestone will be handled direct from the boats to the dock and the ore-handling equipment consists of three Brown bridges with 7½-ton buckets.

Additions to the open-hearth department consist of seven 100-ton stationary furnaces, which with changes to the present furnaces make a total of ten 100-ton furnaces in this department.

These will be equipped with waste-heat boilers, Blair ports and valves and four Bradley 12-ft. gas producers on each furnace to be supplied with coal from an overhead storage. Two 125-ton ladle cranes and one 75-ton clean-up crane are also being installed. The 75-ton crane will be used to handle cinder pots and empty steel ladles and can be used as an emergency hot metal crane.

The rolling mills are to consist of an 18-in. Morgan continuous billet mill in connection with the present blooming mill; one 14-in. cross-country bar mill, one 10-in. continuous bar mill, one 7-in. specialty mill, one 84-in. plate mill and one 10-in. specialty mill, all motor driven. The electric power will be furnished from steam-driven turbo-generators operated from blast-furnace-gas-fired and open-hearth waste-heat boilers.

Taylor-Wharton Iron & Steel Company

The most notable improvement made by this company in 1916 was the completion of the new Easton plant of William Wharton, Jr. & Co., Inc., at Easton, Pa. It has been in full operation since the early part of 1916. At the other plants of the company various new machines, cranes, etc., were added during 1916.

Very extensive improvements are contemplated in 1917 to the plant of the Philadelphia Roll & Machine Company, Philadelphia, Pa., consisting principally of added equipment, including steel furnaces and converter.

At the main plant at High Bridge, N. J., the company contemplates for the present only an addition to its power plant and some other equipment, but it may develop later that more extensive improvements will be made.

Wheeling Steel & Iron Company

At this company's Martins Ferry, Ohio, furnace a Heyl & Patterson pig-casting machine has been installed and at its Benwood plant additions have been made to the pipe galvanizing plant and material enlargements made to the tube works building. Six tin mills with finishing equipment have been added to the company's Yorkville plant. These mills were started about Aug. 1, 1916. Work is progressing on six additional mills which will be completed about May 1, 1917, making this a 24-mill plant. Other improvements of a general character have been rather extensive.

Wickwire Steel Company

This company at its plant at Buffalo, N. Y., is building the following, which it is expected will be entirely completed during the first half of 1917:

1 400-ton metal mixer.
8 Morgan gas producers.
4 60-ton basic open-hearth furnaces.
2 ingot heating furnaces.
A combination blooming and billet mill with three two-high stands, two of which are 32 in. and one 24 in.
A double-strand Morgan continuous rod mill.
A wire mill 224 x 320 ft. with 800 wire drawing blocks.
A galvanizing building, 52 x 316 ft.
A nail, barb wire and tack mill 128 x 300 ft., with 75 wire nail, 24 barb wire and 50 tack machines.
A keg and carpenter shop, 30 x 300 ft.
A new machine shop 60 x 300 ft.
A copperas plant.
Additions to office, restaurant, storehouse, laboratory and hospital.

One open-hearth furnace, the metal mixer and some of the gas producers were to be operated in the last few days of 1916 and the blooming, billet and rod mills will be ready about March 1, 1917, with the other equipment going into commission from April to July.

The company states that it will produce with this equipment steel ingots, billets, wire rods, every description of market wire, wire nails, barb wire, plain twisted wire, tacks, copperas, etc., and that the production of steel in the various lines will aggregate about 180,000 tons a year.

Lackawanna Steel Company

This company has developed plans for a new coal crushing plant for the by-product coke plant, the crushers, Bradford breakers and motors for which have been purchased, and it is expected to install these during the first half of 1917. A water softening plant was installed in 1916 at the coke plant power house for treating boiler feed water. Additional equipment is being installed in the benzol plant, increasing the capacity for refined products.

Improved gas washers are being provided in connection with blast furnaces Nos. 5 and 7.

Three new open-hearth furnaces, Nos. 21 to 23 inclusive, were completed and put in operation at the No. 2 plant during the year, while a fourth, furnace No. 24, is now under construction and will be ready to operate in the early part of 1917. In connection with these additional furnaces the gas producer plant was extended and 12 mechanically operated gas producers installed, and also four waste-heat boilers, one for each furnace.

A motor-driven conveyor was installed during 1916 for removing crop ends from the 230-ton shear at No. 1 mill and a similar conveyor is under construction for handling the crops from the steam-operated shear at the same mill, which will be placed in service during the early part of 1917. An extension of 130 ft. is being made to the loading department of this mill and a second 20-ton magnet crane is to be installed for loading rails.

An extension is being made to the gas producer plant for mills Nos. 2 and 3, including three mechanically operated producers, together with coal-handling equipment. One of the continuous heating furnaces in No. 2 mill is being enlarged and remodeled and will be placed in commission in the early part of 1917. New traveling and tilting tables are being built for No. 3 mill roughing. The 60-in. sliding frame cold saw at the storage beds, together with extension to crane runway begun last year, has been completed and placed in operation, increasing the cutting facilities of this department. The second 20-ton gantry for the billet yard, the construction of which was begun in the company's shops in 1915, was placed in service in 1916.

An oiling system was installed in connection with the mill engines at Nos. 4 and 5 mills. A new and larger table engine is being installed on the approach table for No. 4 mill. A new high-duty air compressor is being installed at Nos. 4 and 5 mills to meet the increased requirements at the south end of their plant and will be ready for operation during the early part of the coming year.

An extension has been made to the furnace building at the No. 7 mill and two four-hole soaking pits are being installed, together with an extension to the gas-producer house and the installation of a mechanically operated gas producer.

An additional bar mill to be known as No. 10 mill is under construction and will be completed in the early part of 1917, producing ⅜-in. rounds and under, also small tees, angles and flats. There has been installed and placed in operation during 1916 a 5-stand, 3-high, 16-in. hand mill for producing rounds, flats, etc., known as mill No. 11.

A steam-turbine-driven duplex hydraulic pump is being installed in power house No. 1 to take care of increased hydraulic power requirements. Three air compressors were also installed in power house No. 1 during the year. A 20,000,000-gal. steam-turbine-driven centrifugal pump is being installed in the pumping station and will be completed during the early

part of 1917. Economizers are being installed in connection with the boilers on the east side of boiler house No. 2.

There were installed in the roll shop two 26-in. and one 18-in. roll lathes, and a 48-in. necking lathe will be completed early in 1917. Additional tools were purchased for the machine shop, consisting of four 17-in., one 25-in. and one 36-in. lathes, a 60-in. boring mill and a keyseat milling machine, all of heavy-duty type and equipped with individual motor drives.

The company also has under construction 35 double houses in its Ridge Road village, for housing workmen.

Inland Steel Company

The main items of new construction and improvement work this company has begun since Jan. 1, 1916, some of which is finished and some in process, are as follows:

1 500-ton blast furnace with stoves, ore bridges, etc.
1 pig casting machine.
44 Koppers coke ovens, making 130 in all, as additions to the by-product coke plant.
1 40-in. blooming mill.
1 32-in. billet mill.
1 28-in. structural mill.
8 80-ton open-hearth furnaces (finished).
2 80-ton open-hearth furnaces (under construction).

All of the above are of the heaviest and latest type housed in all-steel buildings of heavy construction. All the equipment will be electrically driven and this includes motors, a turbine station and boilers, both direct fired and waste heat.

Other improvements include gas producers, laboratory, locomotives, trestles, new pumping station, round house for locomotives, roll shop and equipment and other necessary adjuncts to work of the above character. Much new and expensive dock work was necessary.

Whitaker-Glessner Company

During 1916 this company has undertaken the construction of one 500-ton blast furnace at Portsmouth, Ohio, upon which work is progressing satisfactorily and which it is hoped will be in blast during the summer of 1917. The company completed two 60-ton open-hearth furnaces in 1916 and will finish a third in January, 1917. Three new four-hole soaking pits were constructed in 1916 and a new stripper building was added. Two new 150-ton ladle cranes were purchased which will be delivered early in 1917, together with one open-hearth charging machine, one new 200-ton stripper crane and a new 7½-ton soaking pit crane. The company expects to complete in 1917 eight additional sheet mills to its sheet mill plant.

A number of machine tools have been added to the machine shop equipment including a 60-in. open-side planer, a horizontal boring, drilling and milling machine, a 42-in. boring mill, a 36-in. lathe, a 32-in. shaper and a 225-lb. wheel press as well as several smaller tools. A new three-story office building of reinforced concrete and brick construction was completed in 1916.

Halcomb Steel Company

Considerable new work has been under way at this company's plant at Syracuse, N. Y., and also at the adjoining plant of the Syracuse Crucible Steel Company, which is a part of the Halcomb Steel Company. Early in 1917 the company will have installed a 24-in. cogging mill, a Belgian rod mill, consisting of single stand 18-in. breaking down rolls, 5 stands of 10-in. and 6 stands of 9-in. which will be motor driven. A new 20-in. sheet mill consists of a breaking down stand and two finishing stands of rolls. This is also motor driven, using Falk herringbone gears for speed reduction. Three new Tate-Jones oil-fired annealing furnaces are being operated. The company has built and has ready to operate four 24-pot crucible furnaces. One new 6-ton Heroult electric furnace is in operation and two others of the same size are on order.

Complete equipment for a new wire mill at the Syracuse Crucible Steel plant is on order and will be ready for use early in the year.

A new forced circulation hot water heating system for all buildings requiring artificial heat in the two plants is ready for operation and exhaust steam from the hammer shop will be used for supplying the heat for the hot water. A modern office building is nearly ready for occupancy.

Allegheny Steel Company

In 1916 this company made the following additions at its plant at Brackenridge, Pa.:

An 85-ton basic open-hearth furnace.
A 100-ton basic open-hearth furnace.
A sheet galvanizing department of about 18,000 tons annual capacity.

The company also has under way the following improvements which will be finished early in 1917:

A 32-in. three-high billet mill.
A four-hole soaking pit furnace.
A 30-ton open-hearth furnace.

Several minor additions have been made, such as cranes, various shears and tools and extensions to buildings.

Lukens Iron & Steel Company

The Lukens Iron & Steel Company, Coatesville, Pa., will complete early in 1917 the largest plate mill in the world. It is a 204-in. 4-high mill driven by a double reversing engine of large size and probably compound condenser. The mill is equipped with pit furnaces, cooling beds, shears, etc. The company also put its big slabbing mill in condition to operate again ofter a long idleness, making at the same time improvements in the machinery as well as putting up new gas producers. A considerable enlargement of the flanging department and also of the Jacobs-Shupert locomotive firebox department was completed. Arrangements were also made to install a large turbo-generator to use exhaust steam supplementing the one now in use.

In the open-hearth department four 75-ton basic open-hearth furnaces were completed, so constructed as to admit of operating them as 90 or 100 ton furnaces later if desired. The building to house these furnaces was made large enough to contain two more which will be completed in 1917.

Gulf States Steel Company

During 1916 this company built at Alabama City, Ala., a new machine shop, 80x240 ft., a steel and brick building with composition roof; new pattern and carpenter shops, 40x80 ft., also brick with composition roof. Two new warehouses of the same construction have been built for the company's finished products, the buildings being 60x380 ft. and 60x480 ft. Sixteen new 4-point barb wire machines and one additional bench for drawing fine wire have been installed.

The company has been constructing 37 Koppers by-product coke ovens with all the necessary attachments for the recovery of tar, sulphate of ammonia, benzol, toluol and naphthalene. This work is about 75 per cent completed.

During 1917 the company expects to complete the by-product coke ovens at Alabama City and to finish the main slope of its iron mine at Shannon which is

being driven 18 ft. by 9 ft. double track and which when completed will be a rock slope 2682 ft. long with a capacity of 2000 tons a day. It purchased in 1916 the Spencer quarry, giving it the control of its own supply of dolomite and during 1917 it will erect a rotary calcining kiln, 7x85 ft., for calcining dolomite. The company has added to its switching facilities 10 hopper bottom and 10 flt steel cars, each 100,000 lb. capacity, and two switching locomotives, one 46-ton and one 80-ton. In 1917, 14 automatic stokers will be installed on the boilers, contract for which is already let.

A service house for the accommodation of at least 1000 men will be installed, of the latest and most complete design.

Republic Iron & Steel Company

At the Bessemer and Brown-Bonnell departments of this company at Youngstown, Ohio, the two largest boiler houses, Nos. 3 and 4, have been reconstructed the past year, and stokers, coal and ash-handling machinery have been added. In connection with this improvement the company has under way the addition of 2500 kw. turbine electric generating capacity at its Haselton furnaces, with the expectation of bringing electric power from these furnaces to the Bessemer and Brown-Bonnell department, thus doing away with the generation of electric power by steam at these latter departments. It is the company's intention from time to time to gradually increase the amount of electric power thus transferred, so that eventually it will do away with all of the older boiler plants at those departments, leaving at those plants only the two large boiler houses which have just been modernized and brought up to date. The turbo generators added at the Haselton furnaces will be operated by steam produced by blast-furnace gases. In connection with this improvement the company is also replacing all old type gas burners at the Haselton furnaces with modern and more economical ones.

The company has also completed at its Bessemer and Brown-Bonnell departments the following improvements:

Billet and scrap yard crane runways for the Bessemer department.

Gas producer house at No. 1 10-in. continuous mill and skelp mill formerly operated on producer gas.

No. 2 10-in. continuous mill. This mill was formerly operated at the Moline plant but has been moved to the Brown-Bonnell plant and is now in operation.

Wash rooms, locker rooms at machine shops and other points in the Bessemer and Brown-Bonnell mills.

At the tube works the company has completed one butt-weld and one lap-weld mill, increasing the capacity 50 per cent, and has also extended its galvanized department, blacksmith shop, etc., to correspond.

At the company's open-hearth department a gas producer house, to take care of two furnaces which were formerly worked on natural gas, has been added, and a complete water softening plant is being constructed, together with a metallographic and physical testing laboratory. An extension to the 14-16-in. mill building is being made to provide additional warehouse space.

At the company's Haselton furnaces a complete blast furnace, known as No. 5, is being built to have a capacity of about 550 tons per day. In connection with the new furnace, another railroad bridge across the Mahoning River is being added, together with other collateral equipment.

At the company's Southern plant the principal improvement being made is the opening up of new coal mines on the property at Palos. This mine will be operated largely by electric power, generated at the company's Thomas furnaces. This involves also the addition of electric generators, etc., at the furnaces to provide the necessary power.

An extension has been made to the 90-in. plate mill, considerably increasing its capacity.

The company has in mind some large additions to be made to its steel works and finishing mills at Youngstown during 1917, and may take up some new lines of products. Definite decision regarding these extensions will be made early this year.

Youngstown Iron & Steel Company

Last fall this company began the erection of a 75-ton open-hearth furnace at its Lowellville, Ohio, plant, which will give a total of four furnaces of this capacity, and with an ingot output of about 18,000 tons per month. It is installing at this plant a scrap storage yard with two Morgan 10-ton electric cranes, and is also installing a Morgan stripping crane in the open-hearth plant and one 20-ton Morgan crane in the rolling mill. The company has let contracts for an addition to the bar mill building at its Lowellville plant, 264 ft. in length, to be erected by the Fort Pitt Bridge Works, Pittsburgh. It is expected to be completed about Feb. 1, 1917.

At its Haselton, Ohio, works the company is making an addition, 75 x 275 ft., to its press room in the pressed steel department: It is also erecting for this department a 2-story brick and steel fireproof warehouse and assembly room, 60 x 160 ft. This will bring the output of its pressed steel department to about 2500 tons per month. Practically the entire output of this department is agricultural implements and automobile stampings.

Other Steel Works Additions

The Ashland Steel Company, Ashland, Ky., will add to its equipment motor-driven blowers for its cupolas and a new Laughlin continuous furnace for its rod mill in 1917.

The Eagan-Rogers Steel & Iron Company, Crum Lynne, Pa., made the following additions and improvements during 1916: Additional molding machines; new steel flask equipment; an additional 2-ton converter; cleaning room machinery; an additional dust arrester; smoke stack and hood over converters and a narrow-gage railroad in the yard. These improvements have increased the production nearly 100 per cent. For 1917 the company contemplates a new storeroom, tool room, an enlargement for the office, new molding machines and other equipment.

The Atlantic Steel Company, Atlanta, Ga., is now enlarging its three open-hearth furnaces and hopes to complete the work within the next 60 days. It is installing waste-heat boilers at each of the open-hearth furnaces and has provided larger and better equipment for handling the output of the furnaces.

The West Penn Steel Company, Brackenridge, Pa., is erecting an additional 85-ton open-hearth furnace and has placed orders for a 30-ton locomotive crane and a 20-ton traveling crane, increasing the steel output about 25 per cent.

The Canton Steel Company, Canton, Ohio, will build a steel plant in 1917 to make sheet bars for its own requirements. This will include three 50-ton open-hearth furnaces and a continuous blooming and sheet bar mill.

The Timken Roller Bearing Company, Canton, Ohio, recently placed in operation its first 6-ton Heroult electric furnace in its new steel plant, which includes a blooming and bar mill. The plant was designed to make steel for the company's own requirements and the plans provide for the installation of three additional electric furnaces.

The Pacific Coast Steel Company, San Francisco, Cal., completed in 1916 two additional 50-ton open-hearth furnaces and enlarged its present three 30-ton open-hearth furnaces to 50 tons. It also built a 36-in. blooming mill, enabling it to roll structural shapes up to 15-in.

The American Steel Foundries, Chicago, Ill., added two 40-ton basic open-hearth furnaces to its open-hearth department at its plant at Sharon, Pa., in 1916, and is building two more 40-ton furnaces which it will operate in 1917.

The Ashland Iron & Mining Company, Ashland, Ky., is building three 75-ton open-hearth furnaces, two soaking pits and a 36-in. blooming mill, motor-driven.

The Standard Crucible Steel Casting Company, Milwaukee, Wis., in 1916 completed and is operating a 2-ton open-hearth furnace.

Early in 1916 the National Steel Casting Company was organized and later built a plant at New Cumberland, W. Va., installing a 20-ton acid open-hearth furnace. The capacity of the plant is announced to be 200 to 300 tons of castings per month.

The C. Pardee Works, Perth Amboy, N. J., added last year another 50-ton basic open-hearth furnace and auxiliary equipment necessary, as well as additions to its steam and electric power plant. It is also building a new plant for the manufacture of safety nuts for the Standard Safety Nut Corporation, 30 Church Street, New York.

The Eddystone Steel Company, Crum Lynne, Pa., in 1916 started up a 15-ton basic open-hearth furnace and will build two 25-ton furnaces in 1917, if it can obtain the necessary brick. The plant contains one 22-in. billet mill and two 60-in. plate mills.

The Carpenter Steel Company, Reading, Pa., in 1916 added a new steel frame mill building, 70 x 400 ft., to its plant at Riverside, Pa., including a 20-in. 3-high rolling mill driven by a 350-hp. motor. The crane equipment included one 25-ton for the mill, one 10-ton for the annealing department and two 5-ton for the heat treating department. It has plans for construction of two 15-ton open-hearth furnaces. At present it has one 10-ton basic open-hearth furnace.

The Southern California Iron & Steel Company, Los Angeles, Cal., put in operation early last year a 30-ton open-hearth furnace, supplementing its 15-ton furnace.

The Keystone Steel & Wire Company, Peoria, Ill., completed the construction last year of two 75-ton open-hearth furnaces, a 35-in. blooming mill and a Morgan double stand rod mill.

The Gas Traction Foundry Company, Minneapolis, Minn., installed a 2-ton open-hearth furnace in 1916.

The Otis Steel Company, Cleveland, in 1916 completed the rebuilding of its 72-in. plate mill at its Riverside works into an 84-in. mill. It is a three-high mill with roughing and finishing stands.

The Standard Steel Works Company, Burnham, Pa., completed and put in operation in 1916 two 75-ton open-hearth furnaces.

The Cromwell Steel Company, Cleveland, is the name of a company incorporated in 1916. It is building a new plant at Lorain, Ohio, which will contain four 75-ton open-hearth furnaces, with finishing plant. The bulk of its product will be light and heavy forgings for the automobile trade.

The Hewitt Steel Corporation, which bought the plant of the Atha Steel Casting Company, Newark, N. J., in 1916, rebuilt practically the entire plant, consisting of three 30-ton basic open-hearth furnaces. Four new foundry bays were added, each over 400 ft. long, including 30 and 50-ton capacity cranes.

The Penn Seaboard Steel Corporation, Philadelphia, which was organized in 1916 by the amalgamation of the Penn Steel Castings & Machine Company, the Seaboard Steel Casting Company, both of Chester, Pa., and the Baldt Steel Company, New Castle, Del., purchased the steel casting plant at New Haven, Conn., formerly known as the National Steel Foundry. Two 25-ton open-hearth furnaces were completely rebuilt at the latter plant for the making of cast-steel ingots for shells. At its Seaboard plant at Chester, Pa., the company erected a new 25-ton open-hearth furnace.

The Washington Steel & Ordnance Company, Washington, D. C., completed the building of a 35-ton basic open-hearth furnace, supplementing its two 15-ton furnaces.

The Braddock Mfg. Company, steel founder and machinist, Braddock, Pa., is making an addition to its open-hearth building and installing a second 20-ton open-hearth furnace, which it expects to operate early in 1917.

The Llewellyn Iron Works, at Torrance, near Los Angeles, Cal., will start up its new open-hearth steel plant early in 1917.

Crucible Steel Forge Company, Cleveland, producer of alloy and tool steel forgings, has nearly completed a new plant in which it is installing a 2-ton electric induction furnace and is largely increasing its forging capacity.

The N. & G. Taylor Company, Philadelphia, manufacturer of steel bars, billets and tin plate, is increasing the steel making capacity of its plant at Cumberland, Md., by an additional 20-ton open-hearth furnace, together with other equipment necessary.

The Acme Steel Company was incorporated late in 1916 at Akron, Ohio, to establish a plant for the manu facture of converter steel castings.

The Canton Sheet Steel Company, Canton, Ohio, will build an open-hearth steel plant, consisting of three 50-ton open-hearth furnaces, to supply its requirements of sheet bars. Two soaking pits and a combined continuous blooming mill and sheet bar mill are included. Its present equipment includes 12 hot mills, 6 cold mills and a galvanizing department with a capacity of 60,000 tons per year. It put in operation in 1916 eight new hot mills.

The Standard Seamless Tube Company, Pittsburgh, in 1916 started up two 30-ton open-hearth furnaces at its plant at Economy, Pa. It has been turning out ingots for sale in the open market and late in 1916 expected to finish and put in operation new seamless tube mills.

THE STEEL CORPORATION

Very considerable additions were made in 1916 to the large program of new work which the Steel Corporation had laid out at the beginning of that year. Eight blast furnaces, all in the Chicago district, are being added; one of four at Gary being near completion, while four will be built at the National Tube Company's Gary plant. The steel-making additions actually operated in 1916 consist of nine new open-hearth furnaces and the two new Bessemer converters at Donora. Details of new construction completed last year and that now under way or covered by appropriations are given below. Only preliminary work is being done at Ojibway, Ontario, though it is expected that when the plans are actively undertaken they will include four blast furnaces.

Carnegie Steel Company

At the Ohio works of the Carnegie Steel Company three 75-ton open-hearth furnaces were completed in 1916, together with two pit furnaces and the necessary equipment. At the Clairton works two 75-ton open-hearth furnaces were built and put in operation. At the Farrell works in the Sharon district three additional open-hearth furnaces were completed and put in operation. Work under way at Farrell includes additions to the billet and bar mills and their remodel-

ing, also the rebuilding of the ore stockyard equipment for blast furnaces Nos. 1 to 3. A 1500-ton hot metal mixer was completed at open-hearth plant No. 3 of the Homestead steel works. At Homestead also five reheating furnaces for the 84-in. plate mill were provided. An additional wheel unit was finished at the Schoen steel wheel works. Very extensive by-product coke plant construction has been under way at the Clairton works, the program including 640 ovens, a portion of which will be put in operation in 1917. In connection with this plant a considerable order has been placed with the American Bridge Company for steel river barges for conveying coal from the mines.

Important work which the Carnegie Steel Company has under way includes two by-product coke plants, one of 210 ovens at the Ohio works and one of 150 ovens at New Castle, Pa. The McDonald plant in the Girard, Ohio, district, is still under construction. There will be 10 merchant mills comprising three 8-in., two 10-in. and one 12-in. hoop mills; one 18-in. band mill and one 8-in., one 10-in. and one 14-in. bar mills. At the Duquesne works a new 12-in. bar mill is under way and a 20-ton electric refining furnace will be installed at open-hearth plant No. 2. Also at Duquesne a 15,000-kw. steam-turbine-driven generator and a new boiler plant are being provided at No. 2 power house.

Indiana Steel Company

The program of new work at the Gary, Ind., plant of this company is in progress along the lines announced early in 1916. The following are included:

Four blast furnaces of 500 tons capacity each. One may be blown in in January or February.

A duplexing plant consisting of two 25-ton Bessemer converters and two 100-ton tilting open-hearth furnaces with auxiliary equipment.

A 160-in. sheared plate mill.

A 40-in. two-high blooming mill.

Two 10-in. and one 20-in. merchant mills.

Four 3000-kw. electric gas units.

Fourteen waste-heat boilers in open-hearth department No. 1 and two 7500-kw. steam turbine electric units.

A plant for the manufacture of forged steel car-wheels is also under construction.

Illinois Steel Company

At the South works at South Chicago a new duplexing plant is nearing completion, consisting of two 100-ton open-hearth furnaces with auxiliary equipment and two 25-ton Bessemer converters. At the No. 2 open-hearth furnace plant 11 waste-heat boilers are being provided. An electric open-hearth furnace plant has been under construction at the South works, consisting of two 20-ton Heroult furnaces and one 100-ton tilting open-hearth furnace.

At Joliet works, Joliet, Ill., a benzol recovery plant has been completed in connection with the company's by-product coke ovens.

National Tube Company

At the Lorain, Ohio, plant four additional open-hearth furnaces have been practically completed, and two more have been authorized for early construction. One of the four was in operation in December. A 40-in. motor-driven blooming mill was added in 1916. At Lorain a by-product coke plant of 208 ovens has been under construction and additions are being made to the Central electric light and power plant.

Under the name of the Gary Tube Company the National Tube Company has undertaken the construction at Gary, Ind., of a self-contained plant for the manufacture of pipe beginning with the ore. The plans call for ore docks, four blast furnaces of 550 tons to 600 tons per day each; a Bessemer steel plant with two 12-ton converters; a rolling mill with 40-in. blooming mills, power station and water works; two continuous skelp mills, a universal plate mill, a sheared plate mill and five lap and five butt weld furnaces and auxiliary buildings, such as coupling shops, jobbing shop, machine and blacksmith shops and a very large warehouse. About 800 to 1000 houses will be built for employees.

At the Standard works of the Shelby Steel Tube Company, Elwood City, Pa., a new tube rolling mill unit is under construction having a capacity of 145,000 tons of finished tube products. At the same works additional facilities are being provided for the manufacture of cold-drawn seamless tubes 1½ in. and smaller.

American Steel & Wire Company

At the Donora, Pa., steel works the Bessemer portion of a duplexing plant was built in 1916 to operate in connection with 13 existing open-hearth furnaces. Two 25-ton converters were provided.

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NEW ROLLING MILL WORK

The Elyria Iron & Steel Company, Cleveland, Ohio, in 1916 built an addition to its plant 158 x 200 ft., of the same brick and concrete construction as its other buildings. It has also doubled its electrolytic department. The company has in mind additions to its plant in 1917, but definite plans have not been formulated.

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ville, Pa., leased the plant of the Glasgow Iron Company, Pottstown, Pa., and also purchased the Seyfert plate mill at Seyfert, Pa. These two mills give the company a full range of small sized plates from No. 12 gage up to 1¼ in. Extensive repairs were made and at Pottstown three new furnaces were installed.

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ing, also the rebuilding of the ore stockyard equipment for blast furnaces Nos. 1 to 3. A 1500-ton hot metal mixer was completed at open-hearth plant No. 3 of the Homestead steel works. At Homestead also five reheating furnaces for the 84-in. plate mill were provided. An additional wheel unit was finished at the Schoen steel wheel works. Very extensive by-product coke plant construction has been under way at the Clairton works, the program including 640 ovens, a portion of which will be put in operation in 1917. In connection with this plant a considerable order has been placed with the American Bridge Company for steel river barges for conveying coal from the mines.

Important work which the Carnegie Steel Company has under way includes two by-product coke plants, one of 210 ovens at the Ohio works and one of 150 ovens at New Castle, Pa. The McDonald plant in the Girard, Ohio, district, is still under construction. There will be 10 merchant mills comprising three 8-in., two 10-in. and one 12-in. hoop mills; one 18-in. band mill and one 8-in., one 10-in. and one 14-in. bar mills. At the Duquesne works a new 12-in. bar mill is under way and a 20-ton electric refining furnace will be installed at open-hearth plant No. 2. Also at Duquesne a 15,000-kw. steam-turbine-driven generator and a new boiler plant are being provided at No. 2 power house.

Indiana Steel Company

The program of new work at the Gary, Ind., plant of this company is in progress along the lines announced early in 1916. The following are included:

Four blast furnaces of 500 tons capacity each. One may be blown in in January or February.

A duplexing plant consisting of two 25-ton Bessemer converters and two 100-ton tilting open-hearth furnaces with auxiliary equipment.

A 160-in. sheared plate mill.

A 40-in. two-high blooming mill.

Two 10-in. and one 20-in. merchant mills.

Four 3000-kw. electric gas units.

Fourteen waste-heat boilers in open-hearth department No. 1 and two 7500-kw. steam turbine electric units.

A plant for the manufacture of forged steel car-wheels is also under construction.

Illinois Steel Company

At the South works at South Chicago a new duplexing plant is nearing completion, consisting of two 100-ton open-hearth furnaces with auxiliary equipment and two 25-ton Bessemer converters. At the No. 2 open-hearth furnace plant 11 waste-heat boilers are being provided. An electric open-hearth furnace plant has been under construction at the South works, consisting of two 20-ton Heroult furnaces and one 100-ton tilting open-hearth furnace.

At Joliet works, Joliet, Ill., a benzol recovery plant has been completed in connection with the company's by-product coke ovens.

National Tube Company

At the Lorain, Ohio, plant four additional open-hearth furnaces have been practically completed, and two more have been authorized for early construction. One of the four was in operation in December. A 40-in. motor-driven blooming mill was added in 1916. At Lorain a by-product coke plant of 208 ovens has been under construction and additions are being made to the Central electric light and power plant.

Under the name of the Gary Tube Company the National Tube Company has undertaken the construction at Gary, Ind., of a self-contained plant for the manufacture of pipe beginning with the ore. The plans call for ore docks, four blast furnaces of 550 tons to 600 tons per day each; a Bessemer steel plant with two 12-ton converters; a rolling mill with 40-in. blooming mills, power station and water works; two continuous skelp mills, a universal plate mill, a sheared plate mill and five lap and five butt weld furnaces and auxiliary buildings, such as coupling shops, jobbing shop, machine and blacksmith shops and a very large warehouse. About 800 to 1000 houses will be built for employees.

At the Standard works of the Shelby Steel Tube Company, Elwood City, Pa., a new tube rolling mill unit is under construction having a capacity of 145,000 tons of finished tube products. At the same works additional facilities are being provided for the manufacture of cold-drawn seamless tubes 1½ in. and smaller.

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NEW CANADIAN CONSTRUCTION

The Algoma Steel Corporation, Sault Ste. Marie, Ont., added in 1916 a 32-in. billet mill. In the duplex plant two 75-ton stationary open-hearth furnaces were also built. In 1917 a 75-ton stationary open-hearth furnace will be constructed and also a heavy structural mill.

The Dominion Iron & Steel Company, Sydney, Nova Scotia, has under construction a new 400-ton blast furnace. Contracts have been awarded for 120 Koppers by-product coke ovens with a capacity of 11.2 tons of coke each in 24 hours.

The Steel Company of Canada, Ltd., of Hamilton, completed in 1916 and put in operation three 75-ton open-hearth furnaces and doubled its soaking pit capacity. It also made large additions to its shell-forging plant. At its Montreal plant a large addition was made to the shell-finishing plant. A new 75-ton open-hearth furnace is under construction.

The Canadian Car & Foundry Company, Ltd., Montreal, Canada, made such additions to construction and equipment in 1916 as were necessary for the furtherance of munition work, but the company does not consider this as capital expenditure. The company has spent or authorized over $1,000,000 on this line of work, but does not consider this work as of any permanent character.

The Canadian Steel Foundries, Ltd., of Montreal, built at its Welland, Ont., plant two new 25-ton basic open-hearth furnaces, making a total of four, and is now building two more to be completed in February, 1917. It has also installed a 1,000,000-gal. oil storage tank and built a new forge shop for forging 5000 4½-in. shells per day. At the company's Longue Pointe works, Montreal, one 25-ton acid open-hearth furnace was built in 1916, making a total of four. Another furnace of the same type is under construction to be completed in 1917. At the company's Point St. Charles plant, Montreal, one more furnace is contemplated in the early part of 1917. The company is installing at this plant a forge shop for making 6-in. shell forgings at the rate of 4000 per day, commencing March 1, 1917.

The Nova Scotia Steel & Coke Company, New Glasgow, N. S., is erecting a new blast furnace at Sydney Mines, N. S.

The Manitoba Steel Foundries, Ltd., Winnipeg, Canada, has practically completed its new foundry. It will make electric steel both in the form of castings and ingots for rolling and will have a capacity of 8000 to 10,000 tons per year.

The Pacific Steel Products, Ltd., Bridgeport, B. C., is constructing a new open-hearth steel furnace and installing machines for turning out railroad spikes, bolts and nuts.

Witherbee, Sherman & Co.

No important new work was undertaken in 1916 at the iron ore properties of Witherbee, Sherman & Co., in the Port Henry, N. Y., district, but the company has been developing its old properties constantly and its Old Bed, Harmony and Barton Hill deposits have been carried forward extensively so there is now developed ahead in each of these three old deposits a five-year supply of ore at the present rate of mining.

The company has continued the development of the Smith mine, a property two miles northeast of Mineville, which will begin producing early in 1917. The ore is similar to that in the Old Bed, high in metallic iron and approximately 1 per cent in phosphorus. Work has continued at the so-called Sherman mine, a new operation, where the showing for ore is exceedingly favorable. This is about a mile and a half from Mineville, not far from the Smith mine, and both have been connected with the Lake Champlain & Moriah Railroad by an extension of that line. The Sherman mine is now operating and within a few months will produce about 500 tons of ore per day. The phosphorus in this ore is about 0.30 per cent.

The new Champlain Barge Canal is expected to be completed at the opening of navigation in 1917, giving a depth of 12 ft. from Port Henry to New York Harbor. The eleven locks in the canal are of the following dimensions: Usable length, 311 ft.; breadth, 45 ft.; depth over the miter sills, 12 ft. Witherbee, Sherman & Co. have been experimenting with several types of boats during the past season and the shipments from Port Henry to New York, thence by rail to eastern Pennsylvania furnaces will be increased next season. Owing to the scarcity of boats and the difficulty in having them built, it is not thought that the movement by water will be heavy. Experiments will be continued, however, along the lines of water transportation, and it is expected that individual boats or canal boat fleets, self-propelled, of about 3000 tons capacity, will be developed for one lockage. The matter of transportation is perhaps the most important at present under consideration, as it is expected that ultimately a type of boat will be designed for the movement of ore through the improved waterways to the New York harbor, thence by rail to eastern Pennsylvania, which will cut the transportation costs by approximately 1c per unit of metallic iron.

Wage Advances and Bonuses

The Heald Machine Company, Worcester, Mass., has announced a service bonus of 10 per cent. It will be computed weekly, and service vouchers will be inserted in the pay envelopes. These vouchers will be payable the third Thursday of the succeeding month if the holder of the vouchers is still in the company's employ. To earn a service voucher an employee must have worked 54 hr. out of a 55-hr. week, unless a satisfactory excuse is presented.

The Electric Cable Company, Bridgeport, Conn., has announced a service bonus plan by which employees who live up to the regulations regarding absence from work are to be paid a bonus of 10 per cent of their wages, computed upon a quarterly basis.

The Electrical Alloy Company, Morristown, N. J., presented its employees with a 5 per cent Christmas bonus.

The Allis-Chalmers Mfg. Company, the Kempsmith Mfg. Company, both of Milwaukee, on Dec. 28 announced practically identical plans for extra pay for their employees during 1917 in the sum of 10 per cent of the total individual earnings for the year. Payments will be made quarterly, the first on April 1. Employees leaving the service during the year, or who are discharged for cause, forfeit the right to any extra payments not already received. Those leaving the service because of sickness or other unavoidable reason, or employees discharged other than for cause, will be entitled to extra payments up to the time of leaving. The plan will be in effect for one year from Jan. 1, 1917.

The National Brake & Electric Company, the Bucyrus Company, and the Wisconsin Motor Mfg. Company, all of Milwaukee, on Dec. 30 also announced a 10 per cent bonus plan for all employees in continuous service during 1917, payable quarterly.

An increase in the wages of puddlers was announced last week by the Reading Iron Company, Reading, Pa., making the seventh for 1916. The increase brings the rate for puddling to $8 per ton.

A bonus of 15 per cent was distributed at the end of the year to the employees in the ammunition department of the Bucyrus Steam Shovel Company, Evansville, Ind.

The Goulds Manufacturing Company, Seneca Falls, N. Y., on Christmas gave each of its 900 employees, from the superintendent to the office boys, a full month's pay.

The Status of the Electric Steel Industry

United States Leads All Countries in Furnaces and Output—Progress Since 1910—Furnaces in the World's Steel Industry Now 471

PROGRESS in 1916 in the electric steel industry of the United States and of the world has been phenomenal. It has exceeded the expectations of many. In this development the United States has taken the leading part, and maintains its supremacy by an increased margin over that of a year ago.

On Jan. 1, 1916, as the review of THE IRON AGE, published Jan. 6, 1916, showed, 73 electric furnaces were operating or contracted for in the steel industry in the United States and 8 in Canada. At the opening of 1917 these totals have increased to 136 in the United States and 19 in Canada, or 155 in both countries. This is an increase of 74 furnaces, or 47.7 per cent.

THE IRON AGE published its first list of electric-furnace installations in the world in its issue of April 14, 1910. This amplified a list published by *Stahl und Eisen*, and showed a total of 114 furnaces. The present review of this industry was initiated by THE IRON AGE in its issue of July 1, 1913. The list published then showed that the total had advanced to 140. Two years ago, Jan. 1, 1915, our review made this total 213. In 1915, the electric steel industry made unusual strides, stimulated by the rising tide of war demand for steel, and on Jan. 1, 1916, this review showed that there were 303 electric furnaces in the world's steel industry, a gain of 90 in the year. This remarkable showing has been surpassed in 1916, in spite of the war, or rather, in most cases, because of it. New furnaces, installed or contracted for in 1916 were 168, making the total in the world's steel industry 471 on Jan. 1, 1917—an increase of 35.6 per cent.

The industry has assumed such large proportions that tables of all the present installations in the world are out of the question. Only the extent of the advance from year to year is it now possible to cover in partial detail. In this review, the industry in the United States is covered with almost complete detail, except that the table of Heroult installations covers only those licensed by the United States Steel Corporation in 1916, and supplements the list of all furnaces of that type published a year ago. Tables of the Rennerfelt and Snyder furnaces in the United States are given separately, and also a general table embracing the installations of Grönwall-Dixon, Girod, Wile, Stassano, Greene, induction, and special furnaces. Because of the war, complete data regarding Germany and some of her allies were impossible, but reasonable allowances are made. The final table affords a recapitulation of the world's furnaces Jan. 1, 1917, and those reported in previous reviews.

Progress in the United States in 1916

There has been an increase of 63 furnaces in the United States in 1916, or 46.3 per cent. The total is now 136 as against 73 on Jan. 1, 1916. In Canada the total reported Jan. 1, 1917, is 19 as compared with 8 on Jan. 1, 1916. Some of these, however, were in operation in 1915, but were reported later. The increase in the two countries in 1917 has been 47.7 per cent.

The Heroult furnace continues to take the commanding position in the expansion. On Jan. 1, 1915, there were but 19 furnaces of this type in the United States and Canada; on Jan. 1, 1916, the total was 43, but now it is 84 or a growth of nearly 100 per cent in one year. A significant feature of the past year's development is that only 9 of the new installations in 1916 were in the steel casting industry, the majority going into tool and special steel plants, 5 alone to make seamless tubes. In 1915 the growth was largely in the steel casting industry. The outstanding feature is the decision of the United States Steel Corporation last year to install for itself three 20-ton furnaces, two at the Illinois Steel Company, South Chicago, and one for the Carnegie Steel Company at Duquesne, Pa. The last named is now operating and is capable of making 10 heats per

Table of Heroult Electric Steel Furnaces Operating or Contracted for, as Licensed by the U. S. Steel Corporation, in the United States and Canada During 1916, and Supplementing the List Published in THE IRON AGE, *Jan. 6, 1916*

Company	Location	Furnaces	Size, Tons	Product
UNITED STATES:				
Carpenter Steel Company	Reading, Pa.	2	6	Special and tool steels
General Electric Company	Schenectady, N. Y.	1	1	Tool steels
Anniston Steel Company	Anniston, Ala.	5	6	War material
Vulcan Crucible Steel Company	Aliquippa, Pa.	1	3	Special and tool steels
Timken Roller Bearing Company	Canton, Ohio	4	6	Seamless tubes
Lebanon Steel Foundry	Lebanon, Pa.	1	2	Castings
Firth-Sterling Steel Company	McKeesport, Pa.	1	3	Special and tool steels
W. P. Taylor Company	Buffalo, N. Y.	1	2	Castings
Connecticut Electric Steel Company	New Britain, Conn.	1	2	Castings
Latrobe Electric Steel Company	Latrobe, Pa.	1	6	Special and tool steels
Hess-Steel Corporation	Baltimore, Md.	1	6	Special steels
Vanadium Alloys Steel Company	Latrobe, Pa.	1	3	Special and tool steels
Trojan Electric Steel Company	Chicago, Ill.	1	1	Special and tool steels
Lunkenheimer Company	Cincinnati, Ohio	1	1	Castings
Hussey-Binn Steel Company	Charleroi, Pa.	1	6	Special steels
Carnegie Steel Company	Duquesne, Pa	1	20*	Special steels
Illinois Steel Company	South Chicago, Ill.	2	20*	Rails and special steels
Standard Seamless Tube Company	Economy, Pa.	1	15*	Seamless tubes
Llewellyn Iron Works	Los Angeles, Cal.	1	3	Castings
Damascus Crucible Steel Casting Company	New Brighton, Pa.	1	2	Manganese steel castings
Warman Steel Casting Company	Los Angeles, Cal.	1	2	Castings
Tennessee Coal, Iron & R. R. Company	Easley, Ala.	1	6	Molten ferromanganese
Henry Disston & Sons, Inc.	Tacony, Phila., Pa.	1	3	Saw and tool steel
Warren Steel Casting Company	St. Louis, Mo.	1	2	Castings
Union Electric Steel Company	Pittsburgh, Pa.	1	6	Special and too steels
Halcomb Steel Company	Syracuse, N. Y.	2	6	Special steels
Railway Steel Spring Company	Latrobe, Pa.	1	3	Special steels
Atlas Crucible Steel Company	Dunkirk, N. Y.	1	3	Tool steels
Crucible Steel Company of America	Harrison, N. J.	1	3	Special steels
Millbury Steel Foundry Company	Millbury, Mass.	1	2	Castings
CANADA:				
Armstrong, Whitworth of Canada, Ltd.	Longueuil, Que.	2	3	Tires, wheels and axles

Licensed in the United States in 1916	40
Licensed in Canada in 1916	2
Previously licensed in the United States	39**
Previously licensed in Canada	3
Total in the United States	79
Total in Canada	5

*Charge is hot metal; rest all use cold charge. Practically all are basic.
**One furnace reported a year ago was dropped.

day from hot metal. The two at South Chicago will be operating early this year and, with the two 15-ton Heroult furnaces already making steel there, will go to make the largest electric steel plant in the world.

The installations of Snyder furnaces have increased from 12 in the United States a year ago to 19, with an additional one in Canada, making the total there three.

Table of Snyder Electric Steel Furnaces Operating or Contracted for in the United States and Canada, Jan. 1, 1917

Company	Location	Furnaces Purchased	Product
Crucible Steel Casting Company	Milwaukee, Wis.	1	Steel castings
Otis Elevator Company	Buffalo, N. Y.	2	Steel castings
Gerlinger Steel Casting Company	Milwaukee, Wis.	2	Steel castings
S. Fair & Son	Saginaw, Mich.	1	Steel castings
Niagara Electric Steel Corporation	N. Tonawanda, N. Y.	1	Steel castings
Halcomb Steel Company	Syracuse, N. Y.	1	Tool steel
Sivyer Steel Casting Company	Milwaukee, Wis.	1	Steel castings
Electric Steel Company	Chicago, Ill.	1	Steel castings
Frog Switch & Mfg. Company	Carlisle, Penna.	1	Melting manganese scrap
American Well & Prospecting Company	Corsicana, Texas	1	Steel castings
Monroe Steel Casting Company	Monroe, Mich.	1	Steel castings
Pelton Steel Company	Milwaukee, Wis.	2	Steel castings
Minneapolis Crucible Steel Company	Minneapolis, Minn.	1	Steel castings
Western Crucible Steel Company	Minneapolis, Minn.	1	Steel castings
New London Ship & Engine Co.	Groton, Conn.	1	Steel castings
Pratt & Cady Company, Inc.	Hartford, Conn.	1	Steel castings
Thos. Davidson Mfg. Company	Montreal, Can.	1	Shrapnel bars
Manitoba Steel Fdrys., Ltd.	Winnipeg, Can.	1	Steel castings
Canadian Brakeshoe Company, Ltd.	Sherbrooke, Can.	1	Steel castings

Total in the United States, 19; in Canada, 3.
Besides these, the Haynes Stellite Company, Kokomo, Ind., operates 3 Snyder furnaces producing stellite; the Chicago Bearing Metal Company, Chicago, Ill., operates 2 furnaces producing railroad brass castings and the Snyder Electric Furnace Company itself operates at Chicago 1 furnace making tungsten, 1 furnace making brass and 1 furnace smelting antimony.

The combined total in the two countries is now 22 against 14 on Jan. 1, 1916. The use of the furnace in other lines is important, as in the brass, tungsten and antimony industries, while four furnaces are making ferrosilicon for the British Admiralty in England. Three furnaces are operating in Chile in the chemical industry.

The Rennerfelt furnace has made rapid strides since its appearance in the United States steel industry late in 1915. The total in the United States is now 13 instead of 2 a year ago. The expansion has not been confined to the steel industry, 2 being credited to the brass industry in this country, 11 to ferrotungsten and 1 to the aluminum alloy industry.

The Grönwall-Dixon furnace is also advancing rapidly as a steelmaking unit. A year ago only one was credited to the United States, but now there are 8 in the United States and 1 in Canada. A description of this furnace was published in THE IRON AGE, Sept. 7, 1916. One furnace in the brass industry has been contracted for in 1916—a 500-lb. furnace at the Cleveland Brass Mfg. Company, Cleveland, Ohio.

The increase in furnaces of a special type in the United States in the past year has been five, the total now being seven against two a year ago. Prominent among these is the Greene electric steel furnace, operating basic and making soft steel and manganese steel castings at the Olympic Steel Works, Seattle, Wash. It is built under the designs of the Greene Process Metal Company of St. Louis, and operates under the "Greene slag" process of melting. A special furnace of the company's own design is melting alloys for the Chrome Steel Works, Chrome, N. J. The Crafts furnace, a special induction type, is nearly ready to operate in Cleveland, Ohio. It was described in THE IRON AGE, Sept. 18, 1913.

It is probable that two more Girod 10-ton furnaces will be installed by the Bethlehem Steel Company in 1917.

The apparent net increase of 63 furnaces in the United States in 1916 is really less than the actual, for several of different types, about 10, were dropped during the year.

Developments in Europe

In some countries, notably Great Britain, the war has created such a demand for special castings and shell steel that this has had to be met by electric steel. In this way progress in Europe has been largely determined by the war.

The greatest expansion has been in Great Britain (England). On Jan. 1, 1916, there were 46 furnaces credited to that country against only 16 on Jan. 1, 1915. Our present analysis shows 88 on Jan. 1, 1917, an increase of 42 or nearly 100 per cent. Of this increase 14 are Heroult, making the total of this type 34 in that country. Vicker's Sons & Maxim, Ltd., in 1916, added a 2½ or a 3-ton Heroult furnace, making its total 4; Thomas, Firth & Sons, two 7-ton, two 6-ton, a 2½ and a 1-ton furnace, making its total 8; Samuel Osborn, two 1½-ton furnaces, making its total 3, while Hadfield's, Ltd., made the company's total 10 furnaces by adding four 8-ton, one 3½-ton and one 1½-ton furnace. The Synder has increased its steelmaking furnaces there from 3 to 6 in the year, the Grönwall or Electro-Metals from 12 to 14 and the Rennerfelt from 4 to 7.

A new competitor in the British field appeared in 1916. It is the Greaves-Etchells furnace. It was announced in THE IRON AGE, Nov. 30, 1916, and was originally designed to meet the special requirements of the Sheffield steel industry. Three-phase current is used, three single phase transformers are connected with meshed primaries. To date 20 of these furnaces have been installed or contracted for in England. A description will be printed in an early issue of THE IRON AGE.

In France, 8 Heroult furnaces have been added to the total of the country, which is now 29 against 21 a year ago. Of these 19 are Heroult, 7 Girod, 2 Stassano and 1 Rennerfelt. The war has probably retarded the industry in this country rather than helped it.

In Sweden, the total has advanced from 23 on Jan. 1, 1916, to 40 on Jan. 1, 1917. There is one more Heroult in that country and 14 more Rennerfelts making steel. Two Grönwall-Dixon furnaces have been introduced in 1916. The total in Norway has been brought to 9 as against 6 a year ago by the introduction of 3 more Rennerfelt furnaces.

Table of Rennerfelt Electric Steel Furnaces Operating or Contracted for in the United States, Jan. 1, 1917

Company	Location	Capacity	Product
Crucible Steel Company of America, Crescent Works	Pittsburgh, Pa.	750 lb.	Tool steel
Charleston Steel Company	Charleston, W. Va.	6 ton	Special steels
Charleston Steel Company	Charleston, W. Va.	6 ton	Special steels
American Foundry & Machine Company	Salt Lake City, Utah	3 ton	Steel castings
Skagit Steel & Iron Works	Sedro-Wooley, Wash.	1 ton	Steel castings
The Parsons Company	Newton, Iowa	1 ton	Steel castings
Samson Iron Works	Stockton, Cal.	1 ton	Steel castings
Ducas & Company	New York City	3 ton	Steel ingots
J. Leslie Rodgers	Philadelphia, Pa.	1 ton	Tool steel
Maynard Steel Castings Company	Milwaukee, Wis.	1 ton	Steel castings
Pacific Foundry Company	San Francisco, Cal.	750 lb.	Special iron castings
New Company	Minnesota	3 ton	Steel castings
New Company		1 ton	Steel castings

Total in the United States, 13.
Besides these there are 2 Rennerfelt furnaces, 800 lb. each, in the copper and brass industry respectively; 1 of the same size making ferrotungsten, another making special aluminum alloys and 10 special furnaces making low carbon ferrotungsten.

In Russia, the total is now 16 against 11 on Jan. 1, 1916. The Grönwall or Electro-Metals furnace has entered the field with two installations against none a year ago and the Rennerfelt has increased its total from 4 to 7.

Because of the war, complete information regarding the electric steel industry of Germany and Austria-Hungary has been impossible. The table at the end of this review shows 52 furnaces in Germany instead of 53 a year ago, but this is due to the discontinuance of one Girod furnace. In the column of induction furnaces and opposite the item, "location not given," 12 furnaces are credited. It is probable that these are largely in Germany. The estimate is based on that of German representatives in this country. It is not at all unlikely that the German total is considerably in excess of 52, for that country's electric steel output is now at the rate of nearly 200,000 tons per year as against 130,000 tons in 1915 and 90,000 tons in 1914.

The Heroult leads in the introduction of furnace types in Europe. On Jan. 1, 1916, there were 72 Heroult furnaces in Europe; now there are 97. A year ago there were 33 Rennerfelts across the seas and now there are 57. The Snyder furnace is credited with two more in Europe than a year ago, when it was four, and the Grönwall with 20 instead of 14.

Table of Electric Steel Furnaces, Operating or Contracted for in the United States and Canada, Jan. 1, 1917, Other than the Heroult, Snyder and Rennerfelt

Company	Location	No.	Size, Tons	Charge	Product	Type
Bethlehem Steel Company	South Bethlehem, Pa.	1	10	Cold scrap	Special steel	Girod
Simonds Mfg. Company	Lockport, N. Y.	1	½	Cold scrap	Special steel	Girod
Washington Iron Works	Seattle, Wash	1	3	Cold scrap	Steel castings	Girod
Electric Steel Foundry	Portland, Ore	1	½	Cold scrap	Steel castings	Girod
Pittsburgh Steel Company	Monessen, Pa.	1	1½	.....	Melting ferro-manganese	Wile
Washington Steel & Ordnance Company	Washington, D. C.	1	1	Clod scrap	Steel castings	Stassano
American Iron & Steel Mfg. Company	Lebanon, Pa	2	20	Hot metal	Ingots	Induction
Cleveland City Forge Company*	Cleveland, Ohio	1	2	Cold scrap	Ingots	Induction
Olympic Steel Works	Seattle, Wash	1	¾	Cold scrap	Manganese and soft steel	Greene
The John A. Crowley Company	Detroit, Mich.	1	10	Cold scrap	Special steels	Grönwall-Dixon
The John A. Crowley Company	Detroit, Mich.	1	5	Cold scrap	Special steels	Grönwall-Dixon
Old Dominion Iron & Nail Works Company	Richmond, Va.	1	6	Cold scrap	Special steels	Grönwall-Dixon
Norfolk & Western Railroad	Roanoke, Va.	1	3	Cold scrap	Steel castings	Grönwall-Dixon
Benjamin Iron & Steel Company	Hazleton, Pa.	1	3	Cold scrap	Steel castings	Grönwall-Dixon
United States Electric Steel Company	Pittsburgh, Pa.	1	10	Cold scrap	Steel castings	Grönwall-Dixon
Jessop Steel Company	Washington, Pa.	1	3	Cold scrap	Steel castings	Grönwall-Dixon
Ford Motor Company	Detroit, Mich.	1	500 lb.	Cold scrap	Steel castings	Grönwall-Dixon
Bowmanville Foundry Company	Bowmanville, Ont.	1	500 lb.	Cold scrap	Steel castings	Grönwall-Dixon
Ludlum Steel & Spring Company	Watervliet, N. Y.	5	5	Cold scrap	Tool steel	Special
Chrome Steel Works	Chrome, N. J.	1	1	Cold scrap	Melting alloys	Special
Tivani Electric Steel Company	Belleville, Ont.	1	3	Cold scrap	Tool steel and castings	Special
Canadian Brakeshoe Company	Sherbrooke, Que.	4	2½	Cold scrap	Castings	Special
Canadian Brakeshoe Company	Sherbrooke, Que.	1	1	Cold scrap	Castings	Special
Canadian Cement Company	Montreal, Can.	2	6	Cold scrap	Shells	Special
Wabi Iron Works	New Liskeard, Ont	1	1	Cold scrap	Castings	Special
Eastern Car Company	New Glasgow, N S.	1	6	Cold scrap	Castings	Special

Total within United States and Canada: Girod, 4; Wile, 1; Stassano, 1; Induction, 3; Greene, 1; Grönwall-Dixon, 9; Special, 17=36.

*This company also has one Crafts furnace ready to operate.

Progress in the World

While the United States led the world for the first time a year ago with 73 electric furnaces, displacing Germany for the first time, this country now has the commanding lead of 136 furnaces. In the year Great Britain (or England) has displaced Germany in second place with 88 furnaces on Jan. 1, 1917, against 46 on Jan. 1, 1916. Germany is easily third with probably more than 52, while Sweden still ranks fourth with 40. France and Italy are next with 29 each. The gain in the world's total in 1916 was 168 or 35.6 per cent, or a total of 471 to 303 a year ago.

From the world's point of view, a striking development has been the increase in the use of certain types. The Heroult furnace leads in the total of new installations. Its total a year ago in the world was 115 of this type; now it is 181, a gain of 36.

Rennerfelt furnaces a year ago were 35 in the world's steel industry; now there are 70. There are also 11 in the brass and other industries in Europe and 14 in such industries in the United States.

The Snyder furnace, which had 18 in the steel industry a year ago, now is credited with 28; besides these there are about 10 in other industries.

The Grönwall-Dixon, Grönwall, or Electro-Metals furnace, which a year ago numbered 15 in the world, is now credited with 29, besides the one small furnace (500 lb.) at the plant of the Cleveland Brass Mfg. Company, Cleveland, Ohio.

The induction type is credited with a gain of 12 in the world or 47 against 35 on Jan. 1, 1916. More complete information after the war may increase this.

In 3½ years, or since this review was first published on July 1, 1913, the world's electric steel industry has more than tripled, advancing from a total of 140 to 471. In the same period that of the United States has increased from 19 furnaces to 136, or more than seven times. From the point of view of production the United States probably also leads, that for 1916 without doubt exceeding any other country.

Table of Types of Electric Furnaces by Countries of the World Operating or Contracted for on Jan. 1, 1917, with Totals for 1916, 1915, 1913 and 1910

	Heroult	Girod	Induction	Stassano	Keller	Chapelet	Nathusius	Snyder	Wile	Rennerfelt	Grönwall-Dixon*	Greene	Special	Greaves-Etchells	Total Jan. 1, 1917	Total Jan. 1, 1916	Total Jan. 1, 1915	Total July 1, 1913	Total March, 1910
Germany and Luxemburg	19	5	19	2	3		4								52	53	46	34	30
Austria-Hungary	10	2	3	2						1					18	18	18	10	10
Switzerland	1	2								1					4	4	3	2	2
Italy	4		2	13	5	5									29	22	22	20	12
France	19	7	2						1						29	21	17	13	23
Great Britain	34	1	2	4			6		7	14				20	88	46	16	16	7
Belgium	2	1													3	3	3	3	3
Russia	3	1	1	2					7	2					16	11	9	4	2
Sweden	3		1						34	2					40	23	18	6	5
Norway			2					1	6						9	6	2	3	
Spain			1							1					2	2	1	1	
Japan	1		1												2	1	1	1	
Mexico			1												1	1	1	4	3
Australia										1					1	1	1		
Chile																1			
Roumania	1														1				
Location not given			12											9	21	9	12		
Total outside the United States and Canada	97	19	47	23	8	5	4	6	1	57	20		9	20	316	222	170	118	101
United States	79	4	3	1				19	1	13	8	1	7		136	73	41	19	10
Canada	5							3			1		10		19	8	2	3	3
Total in the United States and Canada	84	4	3	1				22	1	13	9	1	17		155	81	43	22	13
Grand total in the world	181	23	50	24	8	5	4	28	2	70	29	1	26	20	471	303	213	140	114

*Electric-Metals in Great Britain.

Table of Miscellaneous Electric Furnaces, Other than Heroult, Girod, Induction, Rennerfelt, Snyder, Grönwall and Wile, Building or Operating in Europe and Other Countries as Shown by Literature on the Subject. Partly Estimated

Type	No.	Type	No.
Stassano	23	Stobie	4
Keller	8	Anderson	4
Chaplet	5	Soderberg	1
Nathusius	4		
		Total in Europe	49

The accuracy of this table is not vouched for, being based on the best information obtainable owing to the war and other reasons. It is believed to be nearly correct.

British Electric Steelmakers to Make Their Own Electrodes

Practically all the electrodes used in electric furnaces in England have been imported from the United States, but recent installations of new furnaces have increased the demand to such an extent that the Electrode Company, Ltd., of Sheffield, England, has been established for making carbon electrodes. The new plant is expected to be in operation by March 1, 1917. The promoters are four firms which have installed or are erecting 23 electric furnaces with a total capacity of 90½ tons. The new company will have an estimated output of from 3000 to 5000 tons per year.

Importation of manganese ore at Philadelphia amounted to 173,866 gross tons in 1916 as against 13,970 gross tons in 1915.

ESTABLISHED 1855

THE IRON AGE

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Published Every Thursday by the DAVID WILLIAMS CO., 239 West Thirty-ninth Street, New York

W. H. Taylor, *Pres. and Treas.* Charles G. Phillips, *Vice-Pres.* Fritz J. Frank, *Secretary* M. C. Robbins, *Gen. Mgr.*

BRANCH OFFICES—Chicago: Otis Building. Pittsburgh: Park Building. Boston: Equitable Building. Philadelphia: Real Estate Trust Building. Cleveland: Guardian Building. Cincinnati: Mercantile Library Building.

Subscription Price: United States and Mexico, $5.00 per year; single copy, 20 cents; to Canada, $7.50 per year; to other foreign countries, $10.00 per year. Entered at the New York Post Office as Second-class Mail Matter.

1916: Greatest of Steel Years

Nineteen hundred and sixteen was the greatest year the American steel trade has known. It was by far the greatest in output; in the profits realized by producers; in the rate of wages paid to workmen; in the percentage of the product sent abroad—whichever of the common measures is applied, the pre-eminence of the year is established. It was not a year of noteworthy technical advance; no improvements of first-class importance in the processes of iron and steel manufacture were developed. But that fact might be taken as corroborating the outstanding records in other respects, for the demands upon the machinery of production were so unprecedented that every energy of the makers was called into play to meet them.

Following a custom of years, THE IRON AGE gives on other pages of this first issue of 1917 the history of 1916 in iron and steel, as written originally, and in detail, in our weekly records of the markets. In passing, it may be said that in no year since iron market reporting, as instituted by THE IRON AGE, took its place in commercial journalism have the comments of this paper on American steel trade developments had wider currency. In all the capitals and industrial centers of Europe, in these months of the great war, a cabled summary of each week's review has been published regularly, in spite of embargoes on other kinds of information. All Europe, the Teutonic Allies not excepted, wanted to know promptly the facts about the supply and the price of American steel sinews of war.

The charts of prices and of production found elsewhere give sharply ascending curves for 1916, and the statistical tables that go with them leave no uncertainty as to the financial results. With output one-third greater than in the greatest preceding year, and prices yielding profits three, six and more times the average of recent years, it is not surprising that deferred dividends on preferred stock were paid off, notes wiped out and bonds called in, and that on some common stocks dividends were paid that were not looked for in years.

Great as were the production records of the year they might have been greater but for the limitations on coke supply, due to labor scarcity and lack of cars and locomotives, and to the continued hamperings of inadequate transportation. Pig-iron output, at 39,450,000 tons, was one-third greater than in 1915. Lake Superior ore shipments at 66,000,000 tons went 19,000,000 tons beyond the total of 1915, and were 16,000,000 tons greater than the record made in 1913. Steel production was probably in excess of 42,000,000 tons. The previous high record was 32,151,000 tons in 1915.

The historian seeking to epitomize the insatiate demand for steel in 1916 will be able to put it in two words—shells and ships. The Entente powers pressed American steel makers for war steel from the opening of the year to the end, and American shipyards, as is set forth on other pages, made the year memorable with far the largest demand plate mills have ever been called upon to supply—conservatively estimated at 800,000 to 900,000 tons. Plate mills increased their 1915 output by fully 25 per cent, or to an estimated total of 3,500,000 tons. It may fairly be said that war steel and plates account for nearly one-third the country's steel output of last year.

With all its stupendous tonnage and profits, 1916 was not a year of unmixed good to the steel industry. War prices are unhealthy and have stimulated an artificial and unbalanced development of the industry. Profits have come so easily and production has been so uneconomical that a false basis of operations has been created, which must be done away with before the problems of normal times can be rightly attacked. The year's chief service to the industry was in putting it upon a strong financial basis against the lean years that are sure to come at home and the uncertainties of the competition with Europe for a larger share of the steel trade of the world.

Coming Readjustments

The records of 1916, wonderful as they were, well nigh fabulous, make no such appeal to the mind of the maker or user of steel to-day as what he is likely to meet in 1917. A year ago, with the scale of war demand for steel steadily increasing, there was little doubt about 1916. It was not expected to bring peace, and it was a common judgment that the Allies would take all the steel the United States could furnish. Now, the probability that the end of the war will come in 1917 compels some reckoning with the consequences of peace. Readjustments must be made, for no matter how many months it may be delayed, peace has started to make its way into all the plans of the business world.

In the iron trade, iron-ore contracts have been entered into by various companies at the highest prices known since 1890, on which final payments and deliveries are likely to be made after the conclusion of peace. Pig iron has been bought at prices higher than were reached in the boom of 1902-3, or that of 1906-7, which the buyer may be melting when the market, under the readjustments of peace, has receded several dollars a ton from the present level. Finished steel in various forms has been bought for delivery in 1918, when the selling price is likely to be considerably less than the buyer paid.

However, for reasons that have been stated often in connection with the present state of mill congestion, the question of possible cancellations, always raised when the iron and steel markets are facing a transition period, is not an issue to-day. In the falling away from booms in other well-remembered years, the drying up of specifications has come when finished steel was going out from the mill at prices as high as those then current or higher. To-day's prices on some products are $10 or $15 a ton above those paid for most of the steel now being shipped from the mills. Leaving out all other factors, there is thus room for very considerable shrinkage before there would be any temptation to withhold specifications.

Three large considerations have kept the steel market free from any shock, or even fear of shock, from the efforts for peace. First, is the vast amount of steel now on order books—in the case of the Steel Corporation more than at any other time—the greater part of which, both for war and ordinary uses, will be taken out in the months that will intervene before peace can be arranged. Second, is the financial soundness—to speak in moderate terms—of the steel industry and the industries that work up iron and steel. Financial failures, with far-reaching disaster, have been faced in every preceding transition from a great boom. Most producers and manufacturing consumers have acquired surpluses in the past two years beyond anything thought possible in six to eight years of ordinary operation. A third factor is the growing conviction that this country cannot long be prosperous when the countries to which it is chiefly selling are so rapidly wasting away financially.

The steel trade enters upon 1917 expecting readjustment. Some of the changes to be looked for at home are altogether apart from what may result to our trade from the turning of millions of fighting men in Europe into competing producers when the war ends. Here tens of thousands will stop making munitions or other war supplies. For a time there will be more men than jobs. The extravagant bids made by employers in the past eighteen months for the services of inefficient men will give way to wages bearing some relation to the work done. The high unit cost of all production, due to the highest wages ever known and to the insistence of labor on less man efficiency, is the most serious handicap American industry has ever carried into a time of readjustment.

Iron and steel manufacture will not be greatly affected by much of the surplus of labor that may be due to the falling off of war business. As a class, such labor will be of little use in increasing the output of coal and coke or iron ore, where the chief pinch has been. With continued difficulty in increasing raw-material production, the effect of the large increases in steel-making capacity now under way would be felt but gradually.

The loss of steel tonnage itself due to the falling away of shell demand is not expected to be an important factor before the second half of the year in any event. It has been commonly argued that the railroads would take some of the places on mill schedules vacated by the Allied countries, and they may. But at what prices? When prices start to come down from the present impossible levels—impossible for peace times—consumers become onlookers, but not buyers beyond imperative needs. The extent of the railroad buying that is expected to replace war buying will depend on the rapidity with which prices come down to a point giving some assurance of stable equilibrium. It has been said that our own Government's preparedness program will keep many plants busy when war demand slackens. But the very terms of peace may lead to a curtailment of that program.

That peace has come in sight has in no way cleared up the question as to the international movement of steel products after the war. The American steel trade counts on this year to help it to a partial answer. It considers the easy prediction of some commentators that from buying American steel for destruction, Europe will turn to buying it for construction, as at least one for which adequate reasons have not been given. The competition of Allied and Teutonic steel products in the struggle to recover neutral markets and aid in as rapid a return as possible to normal exchange rates, will be a foremost factor. At what point far below war prices can neutral countries be tempted to restock? The rebuilding of Europe, of which so much is said, will be largely outside of the two great producers of steel, and much of the rebuilding can wait, but not the work of reestablishing trade with the world, for which the machinery of production in Germany and Great Britain in iron and steel lines is greater than before the war. What is quite certain is that the steel-producing countries of the world will come into peace times (say late in 1917) with 20 per cent greater steel capacity than they had in August, 1914, and that new peace requirements must come up rapidly if there is to be no slack following the loss of a war demand taking up more than one-third the world's output.

Sixteen Years of the New Century

The sixteen years which have elapsed since the close of the nineteenth century have marked a period of wonderful development in the American iron and steel trade. We began the new century with what was then regarded as the attainment of a triumphant altitude in the progress of the nations. All competitors for prominence in the iron and steel trades had been distanced. Leadership in production was ours. The memory is still fresh of the exultation with which at that time the position of the United States was regarded with respect to other iron and steel making countries. It is therefore hard to realize that in the sixteen years which have since elapsed the United States has

practically tripled its annual production of iron and steel. Other countries, notably Germany, have made substantial progress in this period, but all have been so completely distanced that the crown of the world's iron and steel leadership appears to be in no danger of ever being wrested from this country.

These sixteen years have witnessed the creation of industrial giants in America far surpassing in their size, strength and productive achievements anything the world had before known. Of such commanding potency were some of these aggregations of vast capital and huge operations that fears of their domination of the political affairs of the country were aroused, and measures were devised to check their growth and reduce their power. But the enterprise of American business men was not chilled by the hostility displayed against large undertakings, and although for years the formation of greater companies through mergers was almost completely discouraged, no hesitation was shown in the investment of capital in manufacturing corporations, and many of them have grown by natural accretion from modest proportions to a size which makes them worthy competitors of those who attained much of their growth through mergers.

The past year has been especially favorable for the growth of these independent establishments. The diversion of much of the iron and steel making capacity of Europe to the production of war material, and the heavy demands made on this country by the belligerents, gave our manufacturers an opportunity for profitable expansion such as could never have occurred under other circumstances. Fresh capital has been freely poured into the treasuries of independent corporations in addition to the profits realized from manufacturing on a larger scale than ever before, and the number of manufacturing corporations ranking as big enterprises has greatly increased. A special feature of the year in this connection has been the renewal to some extent of the tendency to form mergers. Unlike the mergers of years ago, however, the consolidations of 1916 have not been the union of establishments making the same class of products, but have been the combination of concerns not in direct competition with one another but making products of a diversified character. The new consolidations are thus fortifying themselves against the danger of a serious loss of business which occasionally besets the manufacturer of only a limited class of products.

This country was never before in such a position of manufacturing strength. It has numerous iron and steel companies of great resources. They are equipped with ample capital, and few are to be found that are not well fortified with a substantial surplus to carry them over a period of depression, if it is not too greatly prolonged or made too strenuous by circumstances beyond their control.

Starved Railroads Choke Industries

In the happenings of the eventful year that has just ended one fact stands out in unpleasant contrast with the noteworthy achievements in practically all other branches of business activity. This is the inability of the railroads to sustain their part in the promotion of the material interests of the country. At a time when the necessities of trade demanded the most systematic and orderly performance of the duties devolving upon our transportation system, it has conspicuously fallen short of meeting the requirements of industrial establishments as well as in the distribution of products needed by the people at large. In the great growth of the business of the country in the past year exasperating demonstration has been frequently made that the railroads have not been able to keep pace with it. The imposition of embargoes on freight shipments for the purpose of restricting traffic within the limit of available transportation facilities has been an extraordinary development, which it may well be believed would have only been resorted to under the most pressing necessity. The immediate causes of this unsatisfactory condition have been a shortage of freight cars, inadequate motive power, and insufficient trackage in freight yards and at terminals.

Some statistics presented in the *Railway Age Gazette* of Dec. 29 are of special value in this connection. While the number of freight cars ordered in 1916 was 170,000, in the five years ended with 1916 the average number of cars ordered was only 148,000. When it is considered that in the five years ended with 1906 the average was over 218,000, and that in the intervening decade the business of this country had increased enormously, the fact is strikingly apparent that the railroads have not been adding to their car equipment as they should have done, even though the carrying capacity of the average freight car is now considerably above that of ten years ago. It is also stated by the same journal that in 1916 the number of locomotives ordered was 2923, and in the five years ended with 1916 the average was only about 2800, against an average of about 4500 in the five years ended with 1906. Thus it is clearly shown that the railroads have fallen far short of keeping their motive power abreast of the growth in the country's business. Moreover, a considerable part of the cars and locomotives ordered in 1916 are yet to be built, and therefore have not been available in a period when they would have proved of most valuable service. These statistics further show that in 1916 only 1098 miles of new railroad were built, being an increase of but 165 miles over 1915, which year had the smallest mileage of new construction in any year since the Civil War. Of second track only 312 miles were built, against 356 miles in 1915 and 565 miles in 1914. Of third, fourth, and other main tracks, only 31 miles were built, as compared with 65 miles in 1915. These are pitifully small figures for a country whose industries are making gigantic strides.

The situation here presented is that of a rapidly growing youth whose old clothes are not only too small, but whose new ones are not large enough for comfort, when they should allow some room for a further increase in girth. It is necessary to go back to the car shortage and traffic congestion of 1906 to find anything approximating the conditions that have for too long a period confronted shippers. But it is pointed out by the *Railway Age Gazette* that 1906 marked the end of a decade in which there had been a great expansion of transportation facilities, whereas the present congestion has appeared shortly after the termination of a period of depression in which the increase of such

facilities has been relatively small. It cannot be said that the predicament in which shippers are finding themselves had not been foreseen. Railroad managers have for years been predicting it, but thus far they have not been able to awaken the great mass of the people to an appreciation of the inevitable result of the hostility to railroads which has so long dominated our legislative bodies. The railroads have been harassed on every side, hampered by restrictive regulations, forced by commissions to expend large sums for purposes not nearly so essential as new equipment, burdened with increased taxes, compelled to submit to almost any exactions of labor, and prevented from advancing freight rates to anything like the extent demanded by the higher cost of all the elements entering into the supplying of transportation. The difference between the rate of development of railroad facilities in the five years ended with 1906 and the like period ended with 1916 is attributed by the *Railway Age Gazette* to the difference in the rate of return earned. In every year of the former period but one the net return of the railroads on their investment in road and equipment exceeded 5 per cent., but in the latter period every year showed a net return of less than 5 per cent, the return for two years—1914 and 1915—being less than 4 per cent.

In view of the poor showing of earnings made in 1914 and 1915, the pinching economy displayed by the railroads in those years and in the greater part of 1916 was to be expected. Their disposition to buy new equipment liberally was shown by the freedom with which they placed orders after it was fully realized that a new era of larger earnings had been entered upon. But nothing now being done in the purchase of equipment will relieve the present plight of furnacemen, who are banking their blast furnaces because of the non-delivery of coke, of steel makers who are restricting operations because necessary raw materials are not being received, of makers of finished products who are unable to satisfy their customers because enough cars cannot be secured to make promised shipments. Unfortunately, the situation is one which will have to cure itself by the temporary restriction of business to the facilities available. A wholesome lesson can be drawn from this experience if it could only be taught to those who need it. The lesson is that the nation cannot thrive as it should if its transportation system is not properly treated.

Iron-Ore Estimate for 1916

The United States Geological Survey estimates the shipments of iron ore from the mines of the United States during 1916 at 75,500,000 gross tons, compared with 55,493,100 tons for 1915. The Survey estimates that the ore sold for $178,935,000 in 1916, an increase of over $77,000,000 compared with 1915. As Lake Superior, with over 66,000,000 tons shipped last year, showed a gain of about 19,000,000 tons over 1915, the above estimate apparently credits an increase of 1,000,000 tons to all iron mines in the country outside of the Lake Superior district.

The American Metric Association, organized in New York City last week for the advancement of the metric system of weights and measures in the United States, has elected George F. Kunz president, and Howard Richards, Jr., secretary, both of New York City.

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Morris, Wheeler & Co.'s New Warehouses

Contracts have been awarded by Morris, Wheeler & Co., iron and steel merchants, now at Sixteenth and Market Streets, Philadelphia, to the William Steele & Sons Company, Philadelphia, for the construction of their new warehouses and offices at Thirtieth and Spruce Streets, backing on the Schuylkill River. The structures provided for include a main warehouse for bars, 120 x 350 ft.; a structural shop, 200 x 330 ft., and a third building, 42 x 200 ft., to contain offices on the second floor and storage room on the first floor, together with garage and stable equipment. All will be of brick, concrete and steel construction. The main warehouse will be fitted with two 5-ton traveling cranes and the structural shop will have two 15-ton and three 5-ton cranes, all motor-driven. Electric power will be used exclusively, and the arrangements provide for strictly up-to-date type of buildings and equipment. The plans include four sidings from the Pennsylvania Railroad tracks on Thirtieth Street. Morris, Wheeler & Co. have arranged to do themselves all the structural steel work in connection with the erection of the buildings. They hope to be able to move into the new quarters before the end of 1917.

PERSONAL

Henry S. Grove has given notice that at the January meeting of the directors he will resign as president of the William Cramp & Sons Ship & Engine Building Company, Philadelphia. At the same time Albert Strauss and Francis L. Hine will resign as directors. The three men have been closely connected in the management of the property in the past 13 years. In a public statement Mr. Grove says: "The present attitude of labor is such that I do not care to be the responsible head of an institution depending upon the loyalty and co-operation of the workman for its success; neither can I reconcile myself to the antagonistic attitude of the Government to ship owners and ship builders."

Important changes have been made in the firm of M. A. Hanna & Co., Cleveland, dealers in iron ore, pig iron, coal and coke, effective Jan. 1. H. M. Hanna, a brother of the late M. A. Hanna, has retired, and three new members, namely, Franklin B. Richards, William Collins and R. F. Grant, have been added to the firm. The old members of the partnership are L. C. Hanna, R. L. Ireland, M. Andrews and H. M. Hanna, Jr. The new members have long been associated with the firm as department heads. Mr. Richards is in charge of the iron-ore and pig-iron sales, Mr. Collins is in charge of the coal sales department, and Mr. Grant is the firm's counsel.

The Chain Belt Company, Milwaukee, announces important changes in its officers. C. R. Messinger has been elected first vice-president. William I. Ballentine, superintendent, is promoted to second vice-president and works manager. C. L. Pfeifer, comptroller, becomes treasurer. Other officers are: Chairman of the board, C. W. Levalley; president, William C. Frye; third vice-president, Frederick L. Sivyer; consulting engineer, Donald Fraser; secretary, William E. Sargent; assistant secretary, G. B. Welser, Jr. Mr. Messinger is also secretary of the Federal Malleable Company and vice-president of the Sivyer Steel Casting Company, both of Milwaukee. Mr. Ballentine joined the Chain Belt Company in October, previously having been president of the Ballentine-Bixby Company, Indianapolis.

E. F. Kenney, metallurgical engineer of the Cambria Steel Company, has been appointed metallurgical engineer of the Midvale Steel Company, Worth Brothers Company and Wilmington Steel Company, effective Jan. 1, He has moved his office from Johnstown, Pa., to the Widener Building, Philadelphia.

James E. Williams, formerly superintendent of the forge division of the Packard Motor Car Company, and who has had the superintendency of the drop forge division of the Washington Steel & Ordnance Company for some years, has acquired an interest in the Pennsylvania Forge Company, Bridesburg, Philadelphia, and will assume his new duties as its general manager about the middle of January.

Manning E. Rupp has been appointed superintendent with the Curtis Pneumatic Machinery Company, St. Louis, Mo.

R. M. Nelson has been appointed assistant purchasing agent of the Chesapeake & Ohio Railway Company, with office at Richmond, Va.

C. E. Middleton has resigned as general manager of the Carbon Steel Company and has been elected vice-president of the Penn Seaboard Steel Corporation, Philadelphia, in charge of its shell operations.

Orlando F. Weber has resigned as vice-president and assistant general manager of the Maxwell Motor Company, Detroit.

Miss Kate Gleason, of the Gleason Works, Rochester, N. Y., and secretary of the Rochester Trailer Company, has been elected vice-president of the Trailer Manufacturers' Association, recently formed at Detroit.

George C. Hicks, Jr., vice-president and engineer of the P. H. & F. M. Roots Company, Connersville, Ind., for the past 15 years, announces his retirement from the company, effective Jan. 1. He will act as consulting engineer for the company for a short time. Before resuming work he expects to take a six months' vacation.

William M. Bastable has been appointed manager of the Baltimore branch of Fairbanks, Morse & Co.

H. B. Carpenter, who has been connected with the Cambria Steel Company for the past nine years in the coke plant department, has resigned to become superintendent of the by-product coke plant of the Colorado Fuel & Iron Company, located at Pueblo, Col., and has taken up his new duties.

John J. Griffin, for some 23 years with the Carnegie Steel Company, has been appointed auditor and assistant treasurer of the American Steel Export Company, Woolworth Building, New York.

W. H. Gibbons has been elected vice-president, secretary and treasurer of the Pulaski Iron Company, Pulaski, Va., and Philadelphia, to succeed the late E. P. Borden. Mr. Gibbons is a banker who several years ago was associated with the Parkesburg Iron Company, Parkesburg, Pa. He has for some time been a director of the Pulaski Iron Company.

Percival Johnson, general manager of the Pulaski Iron Company, has been made a director of the company to fill a vacancy.

Sterling H. Bunnell, of R. Martens & Co., 24 State Street, New York, will sail for England on Jan. 6 by the steamer St. Louis.

Robert Schubert, metallurgist, recently of Birmingham, Ala., sailed for Stavanger, Norway, on Dec. 28 to accept a position with the Stavanger Electro-Steel Company.

Arthur A. Hebert has joined the firm of the E. G. Long Company, 50 Church Street, New York, dealing in electric railroad materials and steel products. He was for 14 years identified with the New York office of the Midvale Steel Company, the latter part of that time as sales manager, before the company was taken over by the Midvale Steel & Ordnance Company, with which company he has since been connected.

Charles U. Carpenter has resigned his connection with the Fireproof Furniture & Construction Company, Miamisburg, Ohio, and has been made works manager of the Recording & Computing Machines Company, Dayton, Ohio.

OBITUARY

P. H. MYNAHAN died suddenly of heart trouble in Massillon, Ohio, Dec. 22, aged 58 years. He had designed and built quite a number of rolling mills. One of them was the plant of the Southern Mfg. Company, now the Atlantic Steel Company, Atlanta, Ga. Later he reconstructed several plants, including a mill at Marietta, Ohio, then operated by the W. F. Robertson Steel & Iron Company, Cincinnati. In 1915 he superintended the construction of a rolling mill at Vancouver, B. C., and at the time of his death he was connected with the Central Steel Company, Massillon, in an advisory capacity. He leaves a daughter.

GEORGE I. SELTZER, in charge of important factory departments of the American Iron & Steel Mfg. Company, Lebanon, Pa., died at his home suddenly Dec. 16, from apoplexy, aged 54 years. He was a native of Lebanon, and had been employed from his youth in the works of the Pennsylvania Bolt & Nut Company and its successor, the American Iron & Steel Mfg. Company. He attained his position largely because of exceptional mechanical skill. He leaves his widow and five sons.

JONES G. MOORE, superintendent of mines of the Sloss-Sheffield Steel & Iron Company, Birmingham, Ala., died suddenly Dec. 30 at his home from acute indigestion, aged 58 years. He had served in many important capacities, among them as president of the Birmingham Southern Railroad until the Tennessee Coal & Iron & Railroad Company absorbed it.

The Lukens Steel Company

The new Lukens Steel Company, which is being incorporated to take over the plant and business of the Lukens Iron & Steel Company, Coatesville, Pa., will have a capitalization of $22,500,000. This will consist of $6,000,000 first preferred cumulative 7 per cent stock, $6,000,000 second preferred cumulative convertible 7 per cent stock and $10,500,000 common stock. All the first preferred stock and a portion of the common have been sold by Philadelphia and New York bankers, many employees of the company being among the buyers. The second preferred, which may be converted into common at par, has not been offered for sale, and it is said that almost all of this entire issue is being held by the present members of the Lukens Iron & Steel Company.

The management of the old company has arranged to keep control of the new company for a long time by the formation of a voting trust. A statement issued by President A. F. Huston gives some interesting figures as follows: In the 14 months ended Dec. 31, 1910, the net profits of the company were $1,000,000; in the year 1911, $300,000; in 1912, $650,000; in 1913, $1,300,000; in 1914, $150,000; in 10 months ended Oct. 31, 1915, $300,000, and in 1916, $3,000,000. Estimates based on the orders now on the company's books place the net profits for 1917 at not less than $8,000,000. The total net tangible assets of the company are in excess of $10,000,000, including net quick assets of $5,000,000.

The new extensions that are being made to the plant represent an investment during the past year of $1,300,000, with approximately $1,500,000 yet to be expended to complete them. The capacity of the plant is now approximately 300,000 tons of plates per annum. With the completion of the new open-hearth furnace plant (four furnaces built in 1916 and two to be ready in February) and the new 204-in. plate mill, this capacity will be increased to approximately 450,0000 tons per annum.

Combining for Argentine Trade

The Argentine Mercantile Corporation, an organization of non-competing manufacturers formed to market American products in Argentina, has just been incorporated in Virginia with a capital of $5,000,000. No competing lines of goods will be represented and the company will sell only to established Argentine merchants, each American manufacturer bearing a share of the expense of distribution, selling and financing in proportion to the extent of his business. By March a building is expected to be ready in Buenos Aires fitted out with samples for display. In addition to these centrally located salesrooms, demonstration grounds with sheds and warehouses for the display of machinery and mechanical appliances will be located on the outer limits of the city. This division will be known as "American Machinery Hall."

Pending the selection of an adequate building on the water front a New York office will be opened in the Bush Terminal. The Buenos Aires headquarters will be established at Calle Defensa Nos. 140-148, adjacent to the Plaza de Mayo. William Hill Hunt, of New York, devised the scheme of organization and made a trip to Argentina to discuss the plan with merchants and importers and to investigate the sales possibilities of 100 lines of merchandise.

The stockholders of the Inland Steel Company will meet Jan. 30 to authorize the formation of a new company under the laws of Delaware, with a capital stock of $30,000,000, of which $25,000,000 will be given in exchange for $10,000,000 of old stock, being at the rate of 2½ shares of new stock for 1 share of the old. The remaining $5,000,000 is to be held for the future.

Henry Potts & Co., 650 Real Estate Trust Building, Philadelphia, have established a department for the sale of structural steel. William M. Boone, of long experience in handling this line, will give the new department his personal attention.

Pittsburgh and Nearby Districts

H. W. Burson has sold his interest in the Colonial Supply Company, Pittsburgh, and organized the Burson Supply Company, with himself as president and with offices in the Arrott Building, Pittsburgh. The new company will handle mine and mill supplies.

The Pittsburgh Steel Company, Pittsburgh, has declared and paid on Jan. 2 a quarterly dividend of $2 a share on the common stock and a special dividend of $20 a share in cash, making $22 in all, amounting in all to $1,540,000. Office employees of the company have received extra compensation to the amount of 10 per cent of their salaries for the year 1916.

The Standard Underground Cable Company, Pittsburgh, declared the regular quarterly dividend of $3 a share, an extra dividend of $3 and a special of $5, making a total of $11, representing $385,000 cash, to be paid on Jan. 10.

The Transcontinental Freight Bureau has made a concession in export rates on tin plate from Pittsburgh and Eastern common points destined for points in British Columbia. R. H. Countiss, agent for the bureau, has notified shippers that the 50c. rate now obtaining, which was to have been advanced to 60c. Jan. 1, will continue until further notice.

The American Malleable Casting Company, Marion, Ohio, will build some additions to its foundry, and will likely be in the market for some foundry equipment.

The Rickert-Shafer Company, Erie, Pa., manufacturer of tools and specialties, will erect a two-story factory on West Twelfth Street.

J. L. Replogle Takes Over Wharton Steel Company

On Dec. 28, J. Leonard Replogle, New York, exercised the option he acquired some time ago on the Wharton Steel Company and took title to the properties at and near Wharton, N. J. The coal and coke properties at Coral, Indiana County, Pa., were not acquired. There are three blast furnaces at Wharton, iron-ore properties and a railroad. The 5000 acres of iron lands near Wharton comprise the Hibernia vein for it full length of about three miles and parallel veins for about five miles. The Wharton & Northern Railroad, owned by the Wharton Steel Company, extends from junctions with the Central Railroad of New Jersey and the D., L. & W. on the south to the New York, Susquehanna & Western Railroad on the north, with a branch to the mines on Hibernia Hill. Included in the smaller iron mines in the Wharton group are the Allen-Teabo, Orchard, Scrub Oaks and Mount Pleasant. The Hibernia mine, the largest, has reserves estimated at 4,000,000 to 5,000,000 tons of ore.

Employees' Steel Stock Subscription

The price at which the United States Steel Corporation will offer stock to its employees under its stock subscription plan this month will be $107 a share. Employees will be given an opportunity to subscribe to 35,000 shares of the common stock. The following table shows the amount of stock subscribed for by employees from 1909 to 1916, with the price they paid:

Year	Common	Price	Preferred	Price
1916	49,742	$85	None	...
1915	None	..	None	...
1914	47,680	57	42,926	$105
1913	25,793	66	34,551	105
1912	30,735	65	30,619	110
1911	29,119	70	19,229	114
1910	None	..	24,672	124
1909	15,318	50	18,000	110

The Elyria Iron & Steel Company, with factories at Cleveland and Elyria, Ohio, has completed a large addition to its Cleveland tube mill, which increases the tube capacity approximately 12,000,000 ft. per year. All buildings are of the latest monitor type construction, with all modern appliances for the safety and convenience of the employees. Facilities for making prompt shipment have been greatly improved, and the company is in position to render prompt service on large quantity shipments.

COKE CURTAILMENT

Many Furnaces Bank in December

Production Over 8000 Tons a Day Less Than in November

The statistic of pig-iron production in December, wired to THE IRON AGE from practically all the active furnaces, and compiled on the second day of January, show that coke shortage caused serious curtailment in some districts. For the 31 days of December the output of coke iron was 3,171,087 gross tons, or 102,293 tons a day, against 3,311,811 tons in the 30 days of November, or 110,394 tons a day. Some furnaces were compelled to bank at intervals in December owing to non-arrival of coke. A good many were banked over Jan. 1, and thus strictly were on the inactive list at the opening of the month, though they may resume any day. Continued handicaps are to be expected in January.

Daily Rate of Production

The daily rate of production of coke and anthracite pig iron by months, from December, 1915, is as follows:

Daily Rate of Pig-Iron Production by Months—Gross Tons

	Steel Works	Merchant	Total
December, 1915	73,647	29,686	103,333
January, 1916	72,614	30,132	102,746
February	75,305	31,151	106,456
March	76,274	31,393	107,667
April	77,226	30,366	107,592
May	77,706	30,716	108,422
June	76,526	30,527	107,053
July	74,397	29,620	104,017
August	74,617	28,729	103,346
September	76,990	29,755	106,745
October	81,639	31,550	113,189
November	80,141	30,253	110,394
December	74,020	28,273	102,293

Capacity in Blast January 1 and December 1

The following table shows the daily capacity in gross tons of furnaces in blast Jan. 1 and Dec. 1 by districts.

Coke and Anthracite Furnaces in Blast

Location of furnaces	Total number of stacks	Jan. 1 Number in blast	Jan. 1 Capacity per day	Dec. 1 Number in blast	Dec. 1 Capacity per day
New York:					
Buffalo	19	15	4,592	15	4,735
Other New York	5	3	532	3	566
New Jersey	6	1	213	1	212
Pennsylvania:					
Lehigh Valley	21	13	3,465	13	3,889
Spiegel	2	2	207	2	200
Schuylkill Valley	12	9	2,334	9	2,356
Lower Susquehanna	6	5	1,355	5	1,449
Lebanon Valley	7	6	852	7	1,021
Ferro and Spiegel	3	3	168	2	148
Pittsburgh District	53	43	21,305	49	22,810
Ferro	3	3	667	3	705
Shenango Valley	19	19	5,887	19	6,280
Western Pennsylvania	24	16	4,653	19	5,980
Ferro and Spiegel	3	2	121	2	124
Maryland	3	3	1,183	3	1,251
Ferro	1	1	109	1	84
Wheeling District	14	13	4,358	14	4,675
Ohio:					
Mahoning Valley	25	22	9,874	23	10,132
Central and Northern	26	21	7,707	23	9,020
Hocking Val., Hang'g R'k, & S. W. Ohio	15	12	1,550	10	1,476
Illinois and Ind.	35	33	16,138	33	16,156
Ferro	2	1	97	1	149
Michigan, Wis. & Minn.	12	10	2,714	11	3,129
Colorado & Missouri	6	4	1,280	3	900
Ferro	1	0	0	1	99
The South:					
Virginia	18	9	1,246	8	969
Kentucky	5	4	594	4	666
Alabama	37	28	7,580	28	7,743
Ferro	1	1	33	1	60
Tennessee	15	9	1,161	9	1,143
Total	399	311	101,975	322	108,127

Among the furnaces blown in between Dec. 1 and Jan. 1 were one Susquehanna in the Buffalo district, one Cambria in western Pennsylvania, Pulaski in Virginia, Mary in the Mahoning Valley, Bessie in the Hocking Valley, one Wellston in the Hanging Rock district, one Bessemer in Alabama and Cumberland in Tennessee.

The furnaces blown out last month include one Josephine and Scottdale in western Pennsylvania, Steubenville in the Wheeling district, one Columbus and two National Tube stacks in Ohio, Thomas in Wisconsin and one Bessemer in Alabama. This list could be lengthened by a number of furnaces in various districts, temporarily banked on Jan. 1, waiting for coke.

Output by Districts

The accompanying table gives the production of all coke and anthracite furnaces in December and the three months preceding:

Monthly Pig-Iron Production—Gross Tons

	Sept. (30 days)	Oct. (31 days)	Nov. (30 days)	Dec. (31 days)
New York	185,483	194,657	183,906	154,496
New Jersey	6,907	7,431	6,384	6,610
Lehigh valley	104,989	122,025	121,948	113,863
Schuylkill Valley	91,483	99,587	90,119	69,543
Lower Susquehanna and Lebanon Valley	64,514	72,574	78,079	73,638
Pittsburgh district	724,183	812,572	723,997	681,133
Shenango Valley	185,276	194,534	183,273	182,482
Western Pennsylvania	183,647	187,764	181,409	173,121
Maryland, Virginia and Kentucky	94,382	97,612	89,100	82,554
Wheeling district	124,034	139,225	140,245	135,102
Mahoning Valley	316,907	339,592	318,181	299,988
Central and Northern Ohio	248,434	273,485	258,609	241,935
Hocking Valley and Hanging Rock	43,948	50,797	50,966	45,819
Chicago district	457,637	504,368	489,158	503,309
Mich., Minn., Mo., Wis. and Col.	121,877	131,389	127,873	127,775
Alabama	219,508	248,863	234,095	245,111
Tennessee	29,157	32,374	34,469	34,608
Total	3,202,366	3,508,849	3,311,811	3,171,087

Production of Steel Companies

Returns from all furnaces of the United States Steel Corporation and the various independent steel companies show the following totals of steel-making iron month by month, together with ferromanganese and spiegeleisen. These last, while stated separately, are also included in the columns of "total production."

Production of Steel Companies—Gross Tons

	Pig, total production 1914	1915	1916	Spiegeleisen and ferromanganese 1914	1915	1916
Jan.	1,261,430	1,115,944	2,251,035	17,325	18,041	24,866
Feb.	1,329,414	1,237,380	2,183,845	10,524	13,319	23,877
Mar.	1,704,688	1,551,082	2,365,116	20,133	12,274	29,388
Apr.	1,635,226	1,584,111	2,316,768	18,676	12,337	31,862
May	1,457,847	1,694,290	2,408,890	21,504	13,440	35,844
June	1,329,623	1,770,657	2,295,784	16,254	19,200	38,597
July	1,395,851	1,949,750	2,306,303	16,524	17,854	31,353
Aug.	1,455,054	2,101,818	2,313,122	11,577	27,463	33,338
Sept.	1,390,322	2,129,322	2,309,710	13,786	23,159	29,451
Oct.	1,271,820	2,281,456	2,530,806	17,435	23,992	34,566
Nov.	1,059,159	2,198,459	2,404,210	21,977	28,741	44,975
Dec.	1,034,802	2,283,047	2,294,620	20,733	25,004	43,470

The Record of Production

Production of Coke and Anthracite Pig Iron in the United States by Months Since Jan. 1, 1912—Gross Tons

	1912	1913	1914	1915	1916
Jan.	2,057,911	2,795,331	1,885,054	1,601,421	3,185,121
Feb.	2,100,815	2,586,337	1,888,670	1,674,771	3,087,212
Mar.	2,405,318	2,763,563	2,347,867	2,063,834	3,337,691
Apr.	2,375,436	2,752,761	2,269,655	2,116,494	3,227,768
May	2,512,582	2,822,217	2,092,686	2,263,470	3,361,073
June	2,440,745	2,628,565	1,917,783	2,380,827	3,211,588
July	2,410,889	2,560,646	1,957,645	2,563,420	3,224,513
Aug.	2,512,431	2,545,763	1,995,261	2,779,647	3,203,713
Sept.	2,463,839	2,505,927	1,882,577	2,852,561	3,202,366
Oct.	2,689,933	2,546,261	1,778,186	3,125,491	3,508,849
Nov.	2,630,854	2,233,123	1,518,316	3,037,308	3,311,811
Dec.	2,782,737	1,983,607	1,515,752	3,203,322	3,171,087
Total, yr.	29,383,490	30,724,101	23,049,752	29,662,566	39,032,792

Diagram of Pig-Iron Production and Prices

The fluctuations in pig-iron production from January, 1908, to the present time are shown in the accompanying chart. The figures represented by the heavy lines are those of daily average production, by months of coke and anthracite iron. The two other curves on the chart represent monthly average prices of Southern No. 2 foundry pig iron at Cincinnati and of local No. 2 foundry iron at furnace at Chicago. They are based on the weekly market quotations of THE IRON AGE.

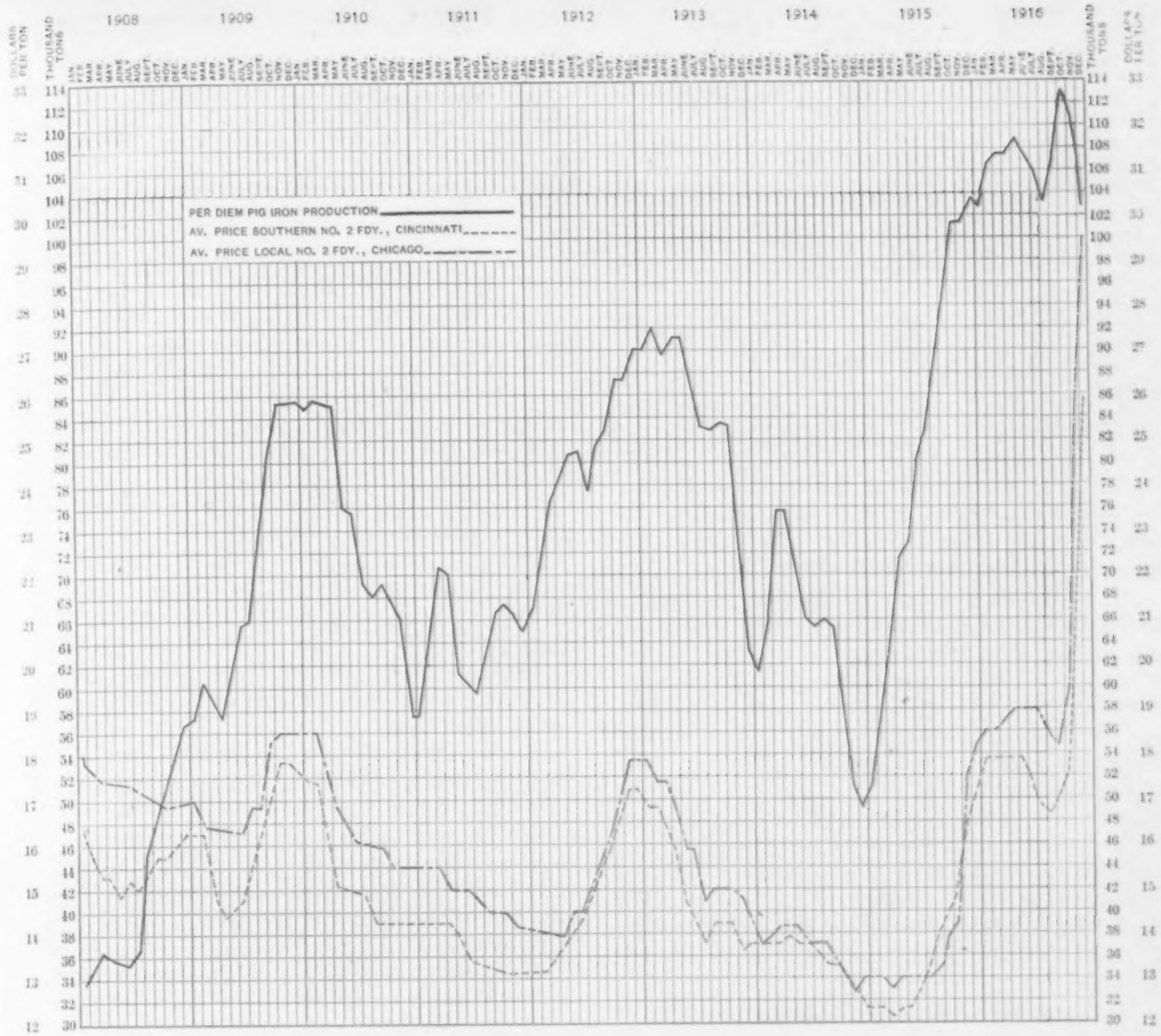


Diagram of Daily Average Production by Months of Coke and Anthracite Pig Iron in the United States from Jan. 1, 1908, to Jan. 1, 1917; Also of Monthly Average Prices of Southern No. 2 Foundry Iron at Cincinnati and Local No. 2 Foundry Iron at Chicago District Furnace

The figures for daily average production, beginning January, 1909, are as follows:

Daily Average Production of Coke and Anthracite Pig Iron in the United States by Months Since Jan. 1, 1909.

Gross Tons

	1909	1910	1911	1912	1913	1914	1915	1916
Jan.	57,975	84,148	56,752	66,384	90,172	60,808	51,659	102,746
Feb.	60,976	85,616	64,090	72,442	92,369	67,453	59,813	106,456
Mar.	59,232	84,459	70,036	77,591	89,147	75,738	66,575	107,667
Apr.	57,962	82,792	68,836	79,181	91,759	75,665	70,550	107,592
May	60,753	77,102	61,079	81,051	91,039	67,506	73,015	108,422
June	64,656	75,516	59,585	81,358	87,619	63,916	79,361	107,053
July	67,793	69,305	57,841	77,738	82,601	63,150	82,691	104,017
Aug.	72,546	67,963	62,150	81,046	82,057	64,363	89,666	103,346
Sept.	79,507	68,476	65,903	82,128	83,531	62,753	95,085	106,745
Oct.	83,856	67,520	67,811	86,722	82,133	57,361	100,822	113,189
Nov.	84,917	63,659	66,648	87,697	74,453	50,611	101,244	110,394
Dec.	85,022	57,349	65,912	89,766	63,987	48,896	103,333	102,293

The small open-hearth furnace at the plant of the South African Steel Works at Vereeniging, Transvaal, South Africa, is being replaced by a larger one, into which has entered locally-made magnesite and silica brick to replace imported material. Castings for the furnace are made at the steel plant, only the valves and chains being imported. Local bituminous coal is to supply the gas for melting. It is expected that the new furnace will produce 1000 tons per month. The original small plant could make only half that amount. Scrap at present is used, but it is claimed that within a few miles of the plant are deposits of high grade iron ore.

The Jones & Laughlin Steel Company, whose Chicago warehouse has been located at Lake and Canal streets for many years, has leased new quarters at Thirty-seventh Street and Ashland Avenue.

Blast Furnace Notes

Mary furnace of the Ohio Iron & Steel Company, Lowellville, Ohio, was blown in Dec. 30. It had been blown out Dec. 1 for relining and repairs, and these were fully completed in less than four weeks.

In the Lehigh Valley, Macungie furnace and one Saucon stack were banked in the last week of December.

Top Mill furnace of the Wheeling Steel & Iron Company was banked Dec. 25 and had not resumed Jan. 1.

In the Mahoning Valley one Hubbard furnace was banked Dec. 23 and one Ohio furnace Dec. 24, and both were idle Jan. 1.

Napier, Helen and Cumberland furnaces in Tennessee were banked several days in the past week on account of coke shortage.

One Columbus Iron & Steel Company stack at Columbus, Ohio, was banked at the beginning of the year for lack of coke.

The Shenango Furnace Company was compelled to bank one of its furnaces ten days in December because of delay in coke deliveries.

Temple furnace at Temple, Pa., was able to run only about half the time in December because of fuel shortage.

Furnaces banked in the Pittsburgh district in the latter part of December and the dates on which they ceased producing were the following: One Clairton, Dec. 19; two Duquesne, Dec. 23 and 24; three Edgar Thomson, Dec. 22, 24 and 28.

Earlston furnace in western Pennsylvania was banked 10 days in December.

Two Rogers-Brown Iron Company furnaces at Buffalo were out part of December, but were producing on Jan. 1.

Iron and Steel Markets

NEW STEEL CAPACITY

Large Additions in 1916 and Yet Larger Building

The Year Begins with Coke Shortage More Menacing and Operation Precarious

The new year opens with the pressure upon steel works and blast furnaces in no degree relaxed and with a notably large inquiry for ship plates, 150,000 tons being now before Eastern mills.

At the same time the difficulties of production and of moving mill products have grown more acute, curtailment of output amounting in some cases to 25 per cent. Many more blast furnaces have had to bank in the past week, after a precarious operation in most of December. Central Western furnacemen are meeting in Cleveland this week to discuss measures of relief.

When every ton of output is needed, the industry is entering on a period of increasingly uncertain deliveries. All the railroad buying of cars and locomotives in recent months will give no relief for the winter, for war work found a hold last year in car and locomotive plants when railroad buying was backward.

Highly significant of the expansion in the demands upon our steel works in the year are the statistics of new steel capacity provided in 1916. A total of 103 open-hearth furnaces completed in 12 months added 4,205,000 tons a year to the country's capacity; yet prices advanced more rapidly in the second half than in the first half of the year. Beyond all precedent is the amount of new steel capacity under construction at the beginning of 1917. From a total of 72 open-hearth furnaces, 11 converters for duplexing and two purely Bessemer steel plants now building or projected, an annual output of 5,015,000 tons a year is expected. The showing starts an interesting speculation as to the relation of steel supply and demand when war buying stops.

While only five new blast furnaces with 800,000 tons yearly capacity were added in 1916, there are now 25 under construction, with a capacity of 4,100,000 tons a year.

Pig-iron production for the 31 days of December fell considerably below that for November with one day less. Telegraphed returns from practically every furnace show 3,171,087 tons for December or 102,293 tons a day, against 3,311,811 tons in November, or 110,394 tons a day.

So many furnaces were banked on Jan. 1 that the capacity active on that day is not a criterion of January production. Our statistics show 311 furnaces active at the opening of the month with capacity of 101,975 tons a day, against 322 furnaces Dec. 1 with capacity of 108,127 tons a day.

We estimate the production of pig iron in 1916 at 39,450,000 tons, putting charcoal iron at 400,000 tons. The previous high year was 1913, with 30,966,152 tons, and the 1915 production was 29,916,213 tons.

Next to shipyard inquiry, exports lead in the current market. France has placed 30,000 tons of barbed wire to be shipped early this year, and details have just been settled of spike and track bolt contracts for several hundred miles of railroad for France. The Italian State Railways want 10,000 tons of squares and rounds in soft steel. Little headway has been made on the shell steel recently sought by England, France and Italy.

Further rail buying for 1918 has come to light, including 55,000 tons for the Southern Pacific, to be rolled at Ensley and 8000 tons for the Chicago & Alton. Frog and switch manufacturers have taken 40,000 tons for 1918.

In the quietest week the pig-iron market has seen in many months the sale of 25,000 tons of Bessemer iron to Italy at $35.50 at Valley furnace stands out prominently. An Eastern company's recent purchase of basic iron amounted to 17,000 tons and another Eastern steel company has bought 5000 tons of ferromanganese for delivery in the next three months.

In the movement of prices the chief feature of the week has been an advance of $4 a ton in iron and steel pipe, black and galvanized, applying also to oil-well supplies and line pipe.

Pittsburgh

PITTSBURGH, PA., Jan. 2, 1917.—(*By Wire.*)

Conditions in the steel trade at the opening of the year 1917 are most satisfactory. The only drawback is the shortage in cars and motive power, but even this has shown slight improvement in the last few days. The consensus of opinion is that as long as the European war lasts prices of steel will be maintained and they may go even higher. The main advance in prices during the week was $4 per ton on black and galvanized iron and steel pipe, oil well supplies and line pipe. While all prices are firm, buyers are holding back to some extent in placing contracts. The output of pig iron, semi-finished steel and finished material is largely sold up for the first half of the new year.

Pig Iron.—Domestic inquiry for Bessemer and basic pig iron is quiet, but the export demand is heavy. A sale has been made of 25,000 tons of standard Bessemer for shipment to Italy, divided among two or three sellers, at $35.50, Valley furnace. Some dealers who have Bessemer and basic iron bought several weeks ago when prices were lower, are offering it at slightly lower prices than the furnaces are naming. One such sale was made by a dealer of 1000 tons of Bessemer at $34, and another of 400 tons was made at $34.50, Valley furnace. Several dealers have offered small lots of basic at about $29, Valley, but we do not hear of any actual sales below $30. A meeting of furnace operators is to be held in Cleveland on Wednesday, Jan. 3, for the purpose of discussing what is best to be done about the coke situation. Deliveries by railroads of coke costing $11 to $12 per ton are no better than on coke costing $3 or $4, and as a result many furnaces have quit buying prompt coke.

A Comparison of Prices

Advances Over the Previous Week in Heavy Type, Declines in Italics

At date, one week, one month, and one year previous

For Early Delivery

Pig Iron, Per Gross Ton:	Jan. 3, 1917.	Dec. 27, 1916.	Dec. 6, 1916.	Jan. 5, 1916.
No. 2 X, Philadelphia	$29.50	$29.50	$28.50	$19.75
No. 2, Valley furnace	31.00	31.00	30.00	18.50
No. 2, Southern, Cin'ti	25.90	25.90	25.90	17.90
No. 2, Birmingham, Ala.	23.00	23.00	23.00	15.00
No. 2 furnace, Chicago*	30.00	30.00	28.00	18.50
Basic, del'd, eastern Pa.	30.00	30.00	30.00	19.50
Basic, Valley furnace	30.00	30.00	30.00	18.00
Bessemer, Pittsburgh	35.95	35.95	34.45	21.95
Malleable Bess., Chigo*	30.00	30.00	28.00	19.00
Gray forge, Pittsburgh	29.95	29.95	29.95	18.45
L. S. charcoal, Chicago	31.75	31.75	31.75	19.25
Rails, Billets, etc., Per Gross Ton:				
Bess. rails, heavy, at mill	38.00	38.00	38.00	28.00
O.-h. rails, heavy, at mill	40.00	40.00	40.00	30.00
Bess. billets, Pittsburgh	60.00	60.00	55.00	32.00
O.-h. billets, Pittsburgh	60.00	60.00	55.00	33.00
O.-h. sheet bars, Pgh	60.00	60.00	55.00	35.00
Forging billets, base, Pgh.	80.00	80.00	80.00	55.00
O.-h. billets, Phila	60.00	60.00	60.00	40.00
Wire rods, Pittsburgh	70.00	70.00	65.00	40.00
Finished Iron and Steel, Per Lb. to Large Buyers:	Cents.	Cents.	Cents.	Cents.
Iron bars, Philadelphia	3.159	3.159	2.909	2.159
Iron, bars, Pittsburgh	3.25	3.25	3.25	1.95
Iron bars, Chicago	3.00	3.00	2.75	1.75
Steel bars, Pittsburgh	3.00	3.00	3.00	2.00
Steel bars, New York	3.169	3.169	3.169	2.169
Tank plates, Pittsburgh	4.25	4.25	4.25	2.25
Tank plates, New York	4.419	4.419	4.419	2.419
Beams, etc., Pittsburgh	3.25	3.25	3.25	1.90
Beams, etc., New York	3.419	3.419	3.419	2.069
Skelp, grooved steel, Pgh.	2.85	2.85	2.85	1.80
Skelp, sheared steel, P'gh.	3.00	3.00	3.00	1.90
Steel hoops, Pittsburgh	3.25	3.25	3.25	2.00

*The average switching charge for delivery to foundries in the Chicago district is 50c. per ton.

Sheets, Nails and Wire, Per Lb. to Large Buyers:	Jan. 3, 1917. Cents.	Dec. 27, 1916. Cents.	Dec. 6, 1916. Cents.	Jan. 5, 1916. Cents.
Sheets, black, No. 28, P'gh	4.50	4.50	4.00	2.60
Sheets, galv., No. 28, P'gh	6.25	6.25	5.50	4.75
Wire nails, Pittsburgh	3.00	3.00	3.00	2.10
Cut nails, Pittsburgh	2.95	2.95	2.95	2.00
Fence wire, base, P'gh	2.95	2.95	2.95	1.95
Barb wire, galv., P'gh	3.85	3.85	3.85	2.95
Old Material, Per Gross Ton:				
Iron rails, Chicago	$27.00	$27.00	$29.00	$17.50
Iron rails, Philadelphia	28.00	28.00	25.00	19.50
Carwheels, Chicago	*19.00*	20.00	21.50	14.75
Carwheels, Philadelphia	22.00	22.00	22.50	16.00
Heavy steel scrap, P'gh	*23.00*	24.00	26.00	17.50
Heavy steel scrap, Phila.	23.00	23.00	24.00	16.00
Heavy steel scrap, Ch'go.	21.50	21.50	23.50	16.00
No. 1 cast, Pittsburgh	*20.00*	21.00	20.50	15.25
No. 1 cast, Philadelphia	21.00	21.00	20.00	17.00
No. 1 cast, Chgo (net ton)	15.50	15.50	16.50	13.75
No. 1 RR. wrot, Phila	27.00	27.00	26.00	22.00
No. 1 RR. wrot, Ch'go (net)	23.50	23.50	26.00	16.00
Coke, Connellsville, Per Net Ton at Oven:				
Furnace coke, prompt	$9.50	$9.50	$7.50	$3.25
Furnace coke, future	**5.00**	4.50	4.00	2.50
Foundry coke, prompt	10.00	10.00	7.50	3.50
Foundry coke, future	**6.50**	6.00	5.00	3.25
Metals,				
Per Lb. to Large Buyers:	Cents.	Cents.	Cents.	Cents.
Lake copper, New York	*29.50*	31.00	34.50	22.87½
Electrolytic copper, N. Y.	*29.50*	31.00	34.50	22.87½
Spelter, St. Louis	9.50	9.50	12.50	17.25
Spelter, New York	9.75	9.75	12.75	17.50
Lead, St. Louis	**7.35**	7.30	7.40	5.40
Lead, New York	7.50	7.50	7.50	5.50
Tin, New York	**43.00**	40.87½	44.37½	45.00
Antimony (Asiatic), N. Y.	**14.50**	14.00	14.00	41.00
Tin plate, 100-lb. box, P'gh	$7.00	$7.00	$6.00	$3.75

New inquiry for foundry and malleable Bessemer iron is quiet. Last week's quotations are continued as follows: Standard Bessemer iron $35; basic, $30 to $31; gray forge, $29; malleable Bessemer, $30, and No. 2 foundry, $31 to $32, all at Valley furnace, the freight rate for delivery in the Pittsburgh or Cleveland district being 95c. per ton. W. P. Snyder & Co. report the average price of Bessemer on sales of 1000 tons or more in December to have been $34.21, or $5.09 over November, and of basic $30, or $2.78 over November, per gross ton, at Valley furnace.

Billets and Sheet Bars.—The market is quiet, mostly for the reason that no new steel is being offered, and it is very hard to find. It is probable that soft Bessemer or open-hearth billets and sheet bars would bring close to $65 at maker's mill for prompt shipment. We continue to quote base sizes and base carbons of Bessemer and open-hearth billets and sheet bars at $60 to $65, maker's mill, Pittsburgh or Youngstown, and forging billets $80 to $85, for sizes up to but not including 10 x 10 in. and for carbons up to 0.25.

Plates.—New orders for cars are quiet. Some fairly large inquiries are out but are slow in being closed. Prices on plates are very strong and domestic demand is urgent from steel-car and shipbuilding interests. We quote ¼-in. and heavier sheared steel plates at 3.60c., with no promise of delivery and from 4c. to 5c. at mill, depending on quantities and deliveries wanted.

Structural Material.—Inquiry is still quite active. The Fort Pitt Bridge Works has taken 2230 tons for repair work for the Poughkeepsie Bridge for the Central Railroad of New England. The McClintic-Marshall Company has taken 600 tons for trestle extensions for the Inland Steel Company, Chicago, and about 3000 tons of steel work for the H. Koppers Company for erection at various Koppers by-product coke plants. We quote beams and channels up to 15 in. at 3.50c. to 4c., depending on the size of the order.

Ferroalloys.—New inquiry is quiet. English 80 per cent ferromanganese is quoted at $160 to $164, seaboard, and domestic at $170 to $175 at furnace; 18 to 22 per cent spiegeleisen, $50 to $55 and 25 to 30 per cent at $65 to $75, delivered; 50 per cent ferrosilicon for delivery next year, in lots up to 100 tons, at $100; 100 tons to 600 tons, $99, and over 600 tons, $98, all per gross ton, f.o.b. Pittsburgh; 9 per cent ferrosilicon, $39 to $41; 10 per cent, $40 to $42; 11 per cent, $41 to $43; 12 per cent, $42 to $44; 13 per cent, $43.50 to $45.50; 14 per cent, $45.50 to $47.50; 15 per cent, $47.50 to $49.50, and 16 per cent, $50 to $52; 7 per cent silvery, $29.50 to $30; 8 per cent, $30 to $31; 9 per cent, $30.50; 10 per cent, $31; 11 per cent, $32, and 12 per cent, $33. These prices are f.o.b. at furnace, Jackson or New Straitsville, Ohio, and Ashland, Ky., all of which have a freight rate of $2 per gross ton to the Pittsburgh district.

Steel Rails.—The Pennsylvania inquiry for 205,000 tons is still pending. The Carnegie Steel Company has taken 25,000 tons for the Erie Railroad. Light rails are quiet, but prices are firm. We quote new light rails as follows: 25 to 45 lb., $50; 16 to 20 lb., $51; 12 and 14 lb., $52; 8 and 10 lb., $53, in carload lots, f.o.b. mill, with usual extras for less than carloads. Standard section rails of Bessemer stock are held at $38, and open-hearth, $40, per gross ton, Pittsburgh.

Sheets.—The new demand is heavy. Most mills are sold up for the first quarter and have booked a large quantity of sheets for the second quarter. The December output was less than in November, due to shortage in steel and labor. The prices quoted by the different mills show a wide range. Quotations on blue annealed sheets, Nos. 3 to 8, are 4c. to 4.25c.; box annealed, one pass, Bessemer cold-rolled sheets, No. 28, 4.50c. to 5c.; No. 28 galvanized, 6.25c. to 7c.; No. 28 tin-mill black plate, 4.25c. to 4.50c., all f.o.b. mill, Pittsburgh. These prices are for carloads or larger lots, the higher prices quoted are for reasonably prompt shipment.

Tin Plate.—Mills are being importuned to name prices for the third quarter. They book orders but at prices to be named later. Several of the leading makers have practically sold their entire output for 1917. We quote for delivery in the first half $7 to $8 per base box, f.o.b. mill. We quote I. C. terne plate, 107 lb., at $7.15 to $7.65, and 200 lb. carrying 8-lb. coating at $11, the usual advances applying for heavier weights and coatings.

Shafting.—The market is quiet but firm. Specifications are not so heavy as some time ago. We quote cold-rolled shafting at 20 to 15 per cent off in carload

lots and 10 per cent off in less than carload lots for first quarter and first half of 1917, f.o.b. Pittsburgh, freight added to point of delivery. The 20 per cent discount is obtainable only on very desirable orders.

Railroad Spikes and Track Bolts.—Spike specifications are active and prices firm. The demand for track bolts is reported heavy. We quote track bolts with square nuts at 4.85c. to 5c. to railroads and 5c. to 5.25c. in small lots to jobbers, base. Track bolts with hexagon nuts take the usual advance of 10c. to 15c. We quote railroad spikes as follows: 9/16 in. and larger, $3.40, base; 7/16 and ½ in., $3.50, base; 5/16 and ⅜ in., $3.75, base; boat spikes, $3.65, base, all per 100 lb., f.o.b. Pittsburgh.

Wire Products.—The demand continues heavy and prices are firm. No advance has been announced although nails have been selling for some time as high as $3.15, base, per keg for fairly prompt delivery. Shipments are slow on account of shortage in car and motive power. Regular prices in effect at this writing are as follows: Wire nails, $3, base, per keg; galvanized, 1 in. and longer, including large head barbed roofing nails, taking an advance over this price of $2, and shorter than 1 in., $2.50. Bright basic wire is $3.05 per 100 lb.; annealed fence wire, Nos. 6 to 9, $2.95; galvanized wire, $3.65; galvanized barb wire and fence staples, $3.85; painted barb wire, $3.15; polished fence staples, $3.15; cement-coated nails, $2.90, base, these prices being subject to the usual advances for the smaller trade, all f.o.b. Pittsburgh, freight added to the point of delivery, terms 60 days net, less 2 per cent off for cash in 10 days. Discounts on woven wire fencing are 53 per cent off list for carload lots, 52 per cent for 1000-rod lots, and 51 per cent for small lots, f.o.b. Pittsburgh.

Wire Rods.—The new demand is active. Most makers are quoting $75 and $80 at mill, and it is said to be hard to obtain any rods at $70.

Iron and Steel Bars.—The new demand is heavy for both iron and steel bars and prices are very firm. Mills report specifications coming in freely. We quote steel bars at 3c. to 3.25c., depending on quantity and deliveries wanted. We quote refined iron bars at 3.25c. and railroad test bars at 3.40c. in carload lots, f.o.b. Pittsburgh.

Nuts and Bolts.—The recent advance is firmly held and the demand is heavy. Makers are back in shipments several weeks. Discounts are as follows, delivered in lots of 300 lb. or more, when the actual freight rate does not exceed 20c. per 100 lb., terms 30 days net, or 1 per cent for cash in 10 days:

Carriage bolts, small, rolled thread, 40 and 10 per cent; small, cut thread, 40 and 2½ per cent; large 30 and 5 per cent.

Machine bolts, h. p. nuts, small, rolled thread, 50 per cent; small, cut thread, 40 and 10 per cent; large, 35 and 5 per cent.

Machine bolts, c. p. c. and t. nuts, small, 40 per cent; large, 30 per cent. Bolt ends, h. p. nuts 35 and 5 per cent; with c. p. nuts, 30 per cent. Lag screws (cone or gimlet point), 50 per cent.

Nuts, h. p. sq. and hex., blank, $2.50 off list, and tapped, $2.30 off; nuts, c. p. c. and t. sq., blank, $2.10 off, and tapped, $1.90 off; hex., blank, $2.50 off, and tapped, $2.30 off. Semi-finished hex. nuts, 50, 10 and 5 per cent. Finished and case-hardened nuts, 50, 10 and 5 per cent.

Rivets, 7/16 in. in diameter and smaller, 45 and 10 per cent.

Rivets.—Most consumers are now covered for the first quarter and first half, and specifications are active. Makers quote buttonhead structural rivets, ½ in. in diameter and larger, $4.25 per 100 lb., base, and conehead boiler rivets, same sizes, $4.35 per 100 lb., base, f.o.b. Pittsburgh. Terms are 30 days net, or one-half of 1 per cent for cash in 10 days.

Cold-Rolled Strip Steel.—On current orders for reasonably prompt shipment makers quote $7 for fair-sized quantities up to $7.50 per 100 lb. for small lots. Terms are 30 days net, less 2 per cent off for cash in 10 days, delivered in quantities of 300 lb. or more when specified for at one time.

Hoops and Bands.—The Carnegie Steel Company now quotes steel hoops at 3.50c. at mill, but with no promise of delivery. Most consumers are covered for first quarter and first half, and specifications are heavy. We quote steel bands at 3.10c. to 3.25c., and steel hoops at 3.50c. to 3.75c., maker's mill.

Wrought Pipe.—Effective Dec. 30, all mills lowered discounts on black and galvanized iron and steel pipe two points, an advance of $4 per ton. The same advance was also made on oil country goods and line pipe, discounts on line pipe in carloads to jobbers now being 54 per cent on 14 to 20 in. O. D., 49 per cent on 21 to 24 in. O. D., and 44 per cent on 26 to 30 in. O. D. The new discounts are given on another page.

Boiler Tubes.—Premiums over regular prices are freely paid for deliveries in two to three months. Discounts are given on another page.

Coke.—Best grades of spot furnace coke have sold as high as $20 per net ton at oven, a record price. The car situation is so bad that it is not likely prices on coke will come down soon to their normal level. Yet prices on prompt coke are lower, due to the fact that blast furnaces have stopped buying coke at $11 and $12 per ton and not getting deliveries on it. The Connellsville coke output is now nearly 100,000 tons less per week than a month or so ago.

Old Material.—Prices have further declined. Consumers are not interested, while railroads are anxious to sell. Some roads have issued special lists out of turn in order to dispose of their scrap if possible. Nominal prices are $1 to $2 per ton lower than last week. Low phosphorus melting stock, which sold up to $36, is $7 to $8 per ton lower. Prices for deilvery in Pittsburgh and at other consuming points that take Pittsburgh freight rates, per gross ton, are nominally as follows:

Heavy steel melting scrap, Steubenville, Follansbee, Brackenridge, Sharon, Monessen, Midland and Pittsburgh, delivered	$23.00 to $24.00
No. 1 foundry cast	20.00 to 21.00
Rerolling rails, Newark and Cambridge, Ohio, Cumberland, Md., and Franklin, Pa.	26.00 to 27.00
Hydraulic compressed sheet scrap	20.00 to 20.50
Bundled sheet scrap, sides and ends, f.o.b. consumers' mills, Pittsburgh district	16.00 to 16.50
Bundled sheet stamping scrap	14.50 to 15.00
No. 1 railroad malleable stock	20.00 to 21.00
Railroad grate bars	10.50 to 11.00
Low phosphorus melting stock	28.00 to 29.00
Iron car axles	43.00 to 44.00
Steel car axles	43.00 to 44.00
Locomotive axles, steel	45.00 to 46.00
No. 1 busheling scrap	17.00 to 18.00
Machine-shop turnings	11.50 to 12.00
Old carwheels	19.00 to 20.00
Cast-iron borings	12.00 to 12.50
*Sheet bar crop ends	25.00 to 26.00
No. 1 railroad wrought scrap	22.00 to 23.00
Heavy steel axle turnings	15.50 to 16.00
Heavy breakable cast scrap	18.00 to 18.50

*Shipping point.

Philadelphia

PHILADELPHIA, PA., Jan. 2, 1917.

Up to the last business day of 1916, specifying and inquiry for steel products were active. In the past week one mill quoted on 75,000 to 100,000 tons of ship plates, and estimates that about 150,000 tons is being sought. Transportation troubles continue to distress the mills, both in regard to deliveries of their products and of raw materials wherewith to manufacture. Prices in every direction are firm. The coke situation continues very bad, and certain furnaces are being banked a day or two at a time to give opportunity for coke replenishment. Stocks of iron at furnaces' banks are low, and some makers of steel-making grades will enter the year with none whatever. A holiday lull has come over the old material market, and prices are nominal.

Pig Iron.—The market has been quiet, with the little buying reported confined to small lots. The situation is a little easier in that producers feel that it is safer for them to sell. Stocks of iron on furnace banks are low and promise to dwindle further because of the interruptions to manufacture. Some furnaces have no stocks. It develops that the eastern Pennsylvania plate mill which was recently in the market for basic took 17,000 tons from various furnaces, paying $30, delivered (from a nearby furnace) for some, and $30, furnace, for the remainder. This mill has plenty of

iron under contract, but has not been getting satisfactory deliveries and entered the market to insure itself against a shortage. In this connection it may be said that with all kinds of iron the pressure for deliveries is a principal feature. A local firm has placed an order for 6000 tons of standard Bessemer for export to Canada in the first half at $35, Valley. Standard low phosphorus has been quieter. Its quotation is unchanged at $52 to $55, delivered. Copper bearing low phosphorus is not far under these figures. Virginia No. 2 X is quoted around $28.50, furnace ($31.25, Philadelphia), and No. 1 at $29, furnace ($31.75, Philadelphia). Some small odd lots of Buffalo iron, more or less special in analysis, are quoted at $35, Buffalo, and over. Quotations for standard brands delivered in buyers' yards, prompt shipment, range about as follows:

Eastern Pa. No. 2 X foundry	$29.50 to $30.50
Eastern Pa. No. 2 plain	29.00 to 30.00
Virginia No. 2 X foundry	29.50 to 30.50
Virginia No. 2 plain	29.25 to 30.25
Gray forge	28.25 to 28.75
Basic	30.00
Standard low phosphorus	52.00 to 55.00

Ferroalloys.—The quotation for domestic 50 per cent ferromanganese is unchanged and strong at $175, delivered, for any position. The nominal quotation for imported is $164, seaboard. Spiegeleisen is in good demand and strong at $55 to $60, delivered, the export inquiry being good. The quotations for 50 per cent ferrosilicon are nominal at $100, Pittsburgh, for carloads, and $99 for 100 tons or more, but much higher prices have been paid for prompt. Some of the manufacturers say they have none to sell. Blast-furnace ferrosilicon is about $48.44, Philadelphia.

Plates.—A mill which has been reluctant to quote on ship plates in the recent past made prices last week on between 75,000 and 100,000 tons wanted by various buyers, and estimates that the aggregate before the trade is at least 150,000 tons. It quotes 6.159c., Philadelphia. Another mill, which also quotes 6.159c., Philadelphia, and which says it has enough business to carry it into the fourth quarter, reports that specifications are so heavy that it would like to see a little slowing up. Two mills quote 4.909c., Philadelphia, for tank plates, and another 4.159c. From the foregoing it will be seen that considerable variance in prices still exists. The activity of the railroads in placing orders for locomotives and cars continues to cause specifications to pile up with the plate makers who have the facilities for serving the car and locomotive builders.

Bars.—The minimum for steel bars is stated to be 3.159c., Philadelphia, or 3c., Pittsburgh, but some makers say the market is nearer 3.409c., Philadelphia. Agricultural interests outside of this district are reported to have bought recently at advantageous prices. Iron bars are strong and active at 3.159c., Philadelphia.

Structural Material.—Conditions have been quieter, but the minimum quotation is unchanged at 3.659c., Philadelphia, for structural shapes, as reported by two makers. No new building operations requiring shapes are before the mills, but a renewal of activity is expected early in the year. Ship shapes are held at 4.159c., Philadelphia, as the minimum.

Billets.—Quotations are unchanged at $60 to $65 for open-hearth rerolling billets, and $75 to $85 for forging steel. Shell steel discards are quoted at $40 to $50, the higher price being for small lots.

Sheets.—No. 10 blue annealed are quoted at 4.909c., Philadelphia. The demand is strong, especially for the lighter gages.

Coke.—The market for coke seems more erratic than ever, with price levels correspondingly difficult to gage. For prompt furnace coke $12, oven, has been paid, also $11, and the range may be given at $9.50 to $12 per net ton at oven. All depends on how acutely coke is needed. Contract furnace is quoted at $5.50 to $6.50 for the year, a large consumer offering $5.25. Prompt foundry is quoted at $11.50 to $12 per net ton at oven, with contract at $6.50 to $7.50, but no one wants to take on commitments. Freight rates from the principal producing districts are as follows: Connellsville, $2.05; Latrobe, $1.85, and Mountain, $1.65.

Old Material.—In a holiday market there is little or nothing to test prices and they are left unchanged, but nominal. It is conceded that when business starts it probably will be at lower levels, for some items at least. Quotations for delivery in buyers' yards in this district, covering eastern Pennsylvania and taking freight rates from 35c. to $1.35 per gross ton, are as follows:

No. 1 heavy melting steel	$23.00 to $24.00
Old steel rails, rerolling	30.00 to 31.00
Low phos. heavy melting steel scrap	33.00 to 36.00
Old steel axles (for export)	45.00
Old iron axles (for export)	45.00
Old iron rails	28.00 to 29.00
Old carwheels	22.00 to 22.50
No. 1 railroad wrought	27.00 to 28.00
Wrought-iron pipe	18.00 to 19.00
No. 1 forge fire	16.50 to 17.50
Bundled sheets	16.50 to 17.50
No. 2 busheling	13.00 to 14.00
Machine-shop turnings	13.50 to 14.00
Cast borings	14.50 to 15.00
No. 1 cast	21.00 to 22.00
Grate bars, railroad	16.00 to 16.50
Stove plate	17.00 to 17.50
Railroad malleable	18.50 to 19.00

Chicago

CHICAGO, ILL., Jan. 2, 1917.—(*By Wire.*)

The year closes with another demonstration of the importance of the railroads in the industrial fabric. It is their purchases which have sustained the volume of business in the holiday week and it is their limitations in point of operations that constitute to-day the most important factor in production. Rail purchases last week added another 25,000 tons to mill orders, track fastenings amounted to 15,000 tons and about 35,000 tons was closed in the form of plates, shapes and bars for cars. Manufacturers in general are exhibiting their chief concern in connection with raw materials and fuel now due or in transit, but latest reports indicate some breaking up of the congestion. Prices of most materials remained stationary in the last week of the year.

Pig Iron.—Deliveries of pig iron due in the latter part of December and the first part of January are generally somewhat delayed, and furnaces are putting especial pressure upon the prompt forwarding of materials upon which their nearby operations are dependent. In this district only two blast furnaces are known to have been banked thus far because of coke shortage or embargoes, and one of these has resumed operations. Very little iron was bought last week. Prices for Northern iron ranged from $30 to $31 and slightly higher, but the quotation for Southern iron at Birmingham remained at $23. There is some increase in the demand for spot iron, but prices are unaffected. For Lake Superior charcoal iron we quote delivery prices at Chicago to include a freight rate of $1.75. The following quotations are for iron delivered at consumers' yards, except those for Northern foundry, malleable Bessemer and basic irons, which are f.o.b. furnace, and do not include a switching charge averaging 50c. per ton:

Lake Superior charcoal, Nos. 2 to 5	$31.75 to $32.75
Lake Superior charcoal, No. 1	32.25 to 33.25
Lake Superior charcoal, No. 6 and Scotch	32.75 to 33.75
Northern coke foundry, No. 1	30.50 to 31.50
Northern coke foundry, No. 2	30.00 to 31.00
Northern coke foundry, No. 3	29.50 to 30.50
Northern high phosphorus foundry	28.00
Southern coke No. 1 f'dry and 1 soft	27.50 to 28.50
Southern coke No. 2 f'dry and 2 soft	27.00 to 28.00
Malleable Bessemer	30.00 to 31.00
Basic	30.00 to 31.00
Low phosphorus	50.00 to 55.00
Silvery, 8 per cent	35.50 to 36.00
Bessemer ferrosilicon, 10 per cent	40.50 to 42.50

Structural Material.—The placing of car steel contributed an important part of last week's business, the aggregate of orders approximating 35,000 tons. Car orders included 1000 hoppers for the Baltimore & Ohio awarded to the Pullman Company, and the Union Pacific has closed for the greater part of its inquiry for 2500. Contracts for fabricated steel were reported placed to the total of about 1100 tons, the American Bridge Company being more than usually active where

the jobs are small. We quote for Chicago delivery of structural steel from mill, 3.289c. to 3.439c.

We quote for structural steel out of jobbers' stocks for Chicago delivery 3.70c.

Rails and Track Supplies.—Further buying of rails in the amount of about 25,000 tons, supplemented by orders for about 15,000 tons of rail fastenings, made up nearly half of the week's tonnage. The year closes with several of the largest railroads' requirements still open. Quotations are as follows: Standard railroad spikes, 3.50c. to 3.60c., base; track bolts with square nuts, 4c. to 4.50c., base, all in carloads, Chicago; tie-plates, $55 to $60, f.o.b. mill, net ton; standard section Bessemer rails, Chicago, $38, base; open-hearth, $40; light rails, 25 to 45 lb., $44; 16 to 20 lb., $45; 12 lb., $46; 8 lb., $47; angle bars, 2.25c.

Plates.—Mills making the effort to cater to prompt shipment business are able to supply only a part of the orders urged upon them. Buying of the car builders was the most important last week. We quote for Chicago delivery of plates from mill, at its convenience, 3.789c.; for prompt shipment, 4.689c. to widths up to 72 in., and for wide plates, 4.939c. to 5c.

We quote for Chicago delivery of plates from jobbers' stocks, 4.35c.

Sheets.—Users of sheets in need of material are dependent largely upon stocks in jobbers' hands. What is available from mills commands prices very nearly as high as those out of store. We quote, for Chicago delivery, No. 10 blue annealed, 4c. to 4.50c.; box annealed, No. 16 and lighter, 4.50c. to 5c.; No. 28 galvanized, 6.50c. to 7c. These quotations are minimum prices for contracts. Early shipment quotations are $5 to $10 per ton higher.

We quote for Chicago delivery out of stock, regardless of quantity, as follows: No. 10 blue annealed, 4.50c.; No. 28 black, 5c.; No. 28 galvanized, 7c.

Bars.—Mill capacity in iron, mild steel and high carbon is almost entirely sold up for as far ahead as the mills are willing to commit themselves. A small amount of new business in iron bars is reported. We quote mill shipment, Chicago, as follows: Bar iron, 3c. to 3.25c.; soft steel bars, 3.189c. to 3.439c.; hard steel bars, 3.25c.; shafting, in carloads, 20 per cent off; less than carloads, 15 per cent off.

We now quote store prices for Chicago delivery as follows: Soft steel bars, 3.60c.; bar iron, 3.60c.; reinforcing bars, 3.60c., base, with 5c. extra for twisting in sizes ½ in. and over and usual card extras for smaller sizes; shafting list plus 5 per cent.

Rivets and Bolts.—Manufacturers report that only a few contracts for the first half remain unclosed and that their commitments for that delivery call for an undiminished operating schedule. We quote as follows: Carriage bolts up to ⅝ x 6 in., rolled thread, 40-10; cut thread, 40-2½; larger sizes, 30-5; machine bolts up to ⅝ x 4 in., rolled thread, with hot pressed square nuts, 50; cut thread, 40-10; large size, 35-5; gimlet-point coach screws, 50; hot pressed nuts, square, $2.50 off per 100 lb.; hexagon, $2.60 off. Structural rivets, ¾ to 1¼ in., 4.15c., base, Chicago, in carload lots; boiler rivets, 10c. additional.

Store prices are as follows: Structural rivets, 4.50c.; boiler rivets, 4.60c.; machine bolts up to ⅝ x 4 in., 40-10-5; larger sizes, 40; carriage bolts up to ⅝ x 6 in., 40-7½; larger sizes, 35; hot pressed nuts, square, $3, and hexagon, $3 off per 100 lb.; lag screws, 50.

Wire Products.—Demand for wire nails and barb wire has continued strong, even through the holiday season, while the inactivity in woven fence remains pronounced because of its relatively high cost. We quote as follows per 100 lb.: Plain wire, Nos. 6 to 9, base, $3.239; wire nails, $3.189; painted barb wire, $3.339; galvanized barb wire, $4.039; polished staples, $3.339; galvanized staples, $4.039, all Chicago.

Old Material.—The week was unusually quiet. Prices were practically stationary, the disposition to await the turning of the year having its effect. The Chicago & Northwestern is offering about 3000 tons of scrap, the Santa Fe 2500 tons and the Pennsylvania and New York Central Lines large lists. We quote, for delivery at buyers' works, Chicago and vicinity, all freight and transfer charges paid, as follows:

Per Gross Ton

Old iron rails	$27.00 to $28.00
Relaying rails	30.00 to 31.00
Old carwheels	19.00 to 20.00
Old steel rails, rerolling	27.00 to 28.00
Old steel rails, less than 3 ft	25.00 to 26.00
Heavy melting steel scrap	21.50 to 22.00
Frogs, switches and guards, cut apart	21.50 to 22.00
Shoveling steel	18.00 to 19.00
Steel axle turnings	14.00 to 14.50

Per Net Ton

Iron angles and splice bars	$27.50 to $28.00
Iron arch bars and transoms	28.00 to 29.00
Steel angle bars	20.50 to 21.00
Iron car axles	36.00 to 37.00
Steel car axles	40.00 to 41.00
No. 1 railroad wrought	23.50 to 24.00
No. 2 railroad wrought	22.50 to 23.00
Cut forge	22.00 to 22.50
Pipes and flues	14.00 to 14.50
No. 1 busheling	17.25 to 17.75
No. 2 busheling	13.00 to 13.50
Steel knuckles and couplers	22.50 to 23.00
Steel springs	23.50 to 24.00
No. 1 boilers, cut to sheets and rings	13.00 to 13.50
Boiler punchings	18.50 to 19.00
Locomotive tires, smooth	23.00 to 23.50
Machine-shop turnings	9.50 to 10.00
Cast borings	9.00 to 9.50
No. 1 cast scrap	15.50 to 16.50
Stove plate and light cast scrap	12.50 to 13.00
Grate bars	13.50 to 14.00
Brake shoes	13.50 to 14.00
Railroad malleable	18.00 to 19.00
Agricultural malleable	15.50 to 16.00

Cast-Iron Pipe.—Of the awards pending, none is reported as closed among the business of municipal origin, but Cleveland is in the market for 6000 tons. We quote as follows, per net ton, Chicago: Water pipe, 4-in., $44.50; 6-in. and larger, $41.50, with $1 extra for class A water pipe and gas pipe.

Buffalo

BUFFALO, N. Y., Jan. 2, 1917.—(*By Wire*)

Pig Iron.—The price situation remains about as rigid as reported last week. The producers of this district manifest little disposition to make concessions. As far as can be learned, very little iron has been obtainable for anything less than $35 per ton, at furnace, for any grade, even in competition with Southern iron, limited tonnages of which have recently been offered in this district at prices netting the buyer a shade under this figure. One Buffalo producer made a price of $34, furnace, on 125 tons of No. 2 plain which it had available, and $30, furnace, for 150 tons of gray forge, everything else being held firmly at $35, furnace. One or two small lots are reported as having been sold at $35.50 for immediate delivery. Lack of coke, labor and cars is still interfering seriously with furnace operation and two of the furnaces of the district continue banked. Other stacks may either bank or blow out on account of uncertainty of coke deliveries and the unrelieved car shortage for shipping the product. The charcoal iron available is being held at $35, Buffalo.

Old Material.—A let-up in buying is reported but no recession from last week's prices is in evidence here. There is a great scarcity of heavy melting steel, and sales are reported at $26 and over; in one instance $27.50 having been paid by a consumer. We continue to quote dealers' asking prices, per gross ton, f.o.b. Buffalo, as follows:

Heavy melting steel	$26.00 to $27.00
Low phosphorus	32.00 to 34.00
No. 1 railroad wrought	30.00 to 31.00
No. 1 railroad and machinery cast	23.00 to 24.00
Iron axles	45.00
Steel axles	45.00
Carwheels	23.00 to 24.00
Railroad malleable	23.00 to 24.00
Machine shop turnings	11.50 to 12.00
Heavy axle turnings	17.50 to 18.00
Clean cast borings	11.50 to 12.00
Iron rails	25.00 to 26.00
Locomotive grate bars	15.50 to 16.00
Stove plate	16.00 to 16.50
Wrought pipe	17.00 to 17.50
No. 1 busheling scrap	21.50 to 22.50
No. 2 busheling scrap	15.00 to 15.50
Bundled sheet scrap	15.00 to 16.00

Finished Iron and Steel.—There has been increased inquiry for carbuilding and shipbuilding material. Large tonnages of commodities are under negotiation for

Canadian shipment. Local domestic transactions, however, have been held somewhat in check by inventory and holiday conditions.

Cleveland

CLEVELAND, OHIO, Jan. 2, 1917.—(*By Wire.*)

Pig Iron.—About the only demand is for small lots of foundry iron for early shipment. Iron stocks in foundry yards are low, and many founders having difficulty in getting iron as fast as needed because of the railroad situation. This condition has caused the buying of iron for early shipment, foundrymen hoping that by placing orders with furnaces other than their regular sources they will run better chances of having a supply should the situation become worse. Prices are unchanged, as follows, f.o.b. Cleveland:

Bessemer	$35.95
Basic	30.95
Northern No. 2 foundry	31.30
Southern No. 2 foundry	$26.00 to 29.00
Gray forge	29.95
Ohio silvery, 8 per cent silicon	38.62 to 39.62
Standard low phos., Valley furnace	50.00 to 51.00

Coke.—Foundry coke is higher, being quoted at $10.50 to $11 per net ton at oven for standard Connellsville makes for prompt shipment, and several foundries have offered the latter price if coke could be supplied. As high as $9 is being quoted for first half foundry coke contracts. Deliveries of furnace coke are somewhat better, but one Cleveland furnace of the American Steel & Wire Company is still banked.

Iron Ore.—Dock shipments are about normal for this time of the year. Furnaces have large stocks of ore and in this respect are not being interfered with by the car shortage. The market is inactive. We quote prices as follows, delivered lower Lake ports: Old range Bessemer, $5.95; Mesaba Bessemer, $5.70; old range non-Bessemer, $5.20; Mesaba non-Bessemer, $5.05.

Finished Iron and Steel.—Some inquiry has come from the implement manufacturers for last-half contracts, but no sales are reported in this territory. There is considerable inquiry for sheets, but mills are declining to quote unless they have some first-quarter tonnage available. Prices are higher. We quote sheets at 5c. to 5.25c., Ohio mill, for No. 28 black; 4.75c. to 5c. for No. 10 blue annealed, and 6.50c. to 7.50c. for No. 28 galvanized. Warehouse prices have been advanced to 5c. for black sheets and 4.75c. for blue-annealed sheets. Other warehouse prices are unchanged. The car situation shows little if any improvement; all industries are affected through inability to secure material or fuel.

Bolts, Nuts and Rivets.—The volume of specifications on expiring bolt and nut contracts was very heavy in the past week, but little business has been booked since the advance in prices. Rivet specifications are coming out frequently and prices are unchanged.

Old Material.—The market is dull and prices are weak. Heavy melting steel scrap has declined about $2 a ton and most other grades are $1 a ton or more lower. About the only trading is between dealers. Local mills are offering only $18 to $20 for heavy melting steel scrap, but sales between dealers are being made at $20 to $22. Shipments are still being seriously interfered with by car shortages and railroad embargoes. We quote, f.o.b. Cleveland, as follows:

Per Gross Ton

Steel rails	$21.00 to $21.50
Steel rails, rerolling	28.00 to 29.00
Steel rails, under 3 ft	28.00 to 29.00
Iron rails	29.00 to 30.00
Steel car axles	50.00 to 52.00
Heavy melting steel	20.00 to 22.00
Carwheels	20.00 to 20.50
Relaying rails 50 lb. and over	37.00 to 38.00
Agricultural malleable	15.50 to 16.00
Railroad malleable	20.00 to 21.00
Steel axle turnings	16.00 to 16.25
Light bundled sheet scrap	14.50 to 15.00

Per Net Ton

Iron car axles	$46.00 to $47.00
Cast borings	9.00 to 9.25
Iron and steel turnings and drillings	9.75 to 10.00
No. 1 busheling	17.50 to 18.00
No. 1 railroad wrought	25.00 to 26.00
No. 1 cast	18.00 to 18.50
Railroad grate bars	12.50 to 13.00
Stove plate	12.50 to 13.00

Cincinnati

CINCINNATI, OHIO, Jan. 2, 1917.—(*By Wire.*)

Pig Iron.—The chief concern now of both seller and buyer is the embargo established by nearly all the railroads. It is almost impossible to get any shipment from the South moved across the Ohio River, and some of the Southern roads even refuse to take Cincinnati shipments. The local foundries, being fairly well stocked, have not yet suffered for want of iron. The Ironton furnaces are able to make outbound shipments to nearly all territory they serve. The inquiry is light, and the only sale of consequence reported in this vicinity was 500 tons of Southern for second and third quarters. Prices are firm and unchanged, $24 to $25 Birmingham, being asked for first half shipment, and $23 to $25 for last half. Northern iron is stationary at $30, Ironton, for any shipment this year, although little, if any, first half business could be taken by the furnaces. Based on freight rates of $2.90 from Birmingham, and $1.26 from Ironton, we quote, f.o.b. Cincinnati, as follows:

Southern coke, No. 1 f'dry and 1 soft.	$26.40 to $28.40
Southern coke, No. 2 f'dry and 2 soft.	25.90 to 27.90
Southern coke, No. 3 foundry	25.40 to 27.40
Southern coke, No. 4 foundry	24.90 to 25.40
Southern gray forge	24.40 to 26.40
Ohio silvery, 8 per cent silicon	37.25 to 38.25
Southern Ohio coke, No. 1	31.76
Southern Ohio coke, No. 2	31.26
Southern Ohio coke, No. 3	30.76
Southern Ohio malleable Bessemer	31.26
Basic, Northern	31.26
Lake Superior charcoal	28.70 to 29.70
Standard Southern carwheel	27.90 to 28.40

Finished Material.—Jobbers' quotations have been advanced in the past few days on almost everything except wire nails and barb wire. Store prices are as follows: Structural shapes, 3.90c.; plates, 4.70c.; blue annealed sheets, 4.65c.; bars, 3.80c.; rounds and squares, 2 in. and over, 4.35c.; flat bars, 1 in. thick and over, 4.35c.; button and round-head rivets, 4.50c.; cold-rolled shafting, 10 per cent plus list; wire nails, $3.40 per keg; barb wire, $4.40 per 100 lb. The mill price on No. 28 black sheets is around 5c., Cincinnati, or Newport, Ky., and on No. 28 galvanized 6.95c. to 7.15c. Business is better than in previous years at this season. There is a slight improvement noted in mill shipments in spite of the car shortage.

Coke.—There is no contracting for future shipment, but a few sales of both foundry and furnace coke were made for spot movement at $12 per net ton at oven.

Old Material.—Business is at a standstill and prices have been reduced 50c. on nearly all grades. The following are dealers' prices, f.o.b. at yards, southern Ohio and Cincinnati:

Per Gross Ton

Bundled sheet scrap	$14.25 to $14.75
Old iron rails	24.50 to 25.00
Relaying rails, 50 lb. and up	28.00 to 28.50
Rerolling steel rails	24.50 to 25.00
Heavy melting steel scrap	20.50 to 21.00
Steel rails for melting	20.50 to 21.00

Per Net Ton

No. 1 railroad wrought	$21.25 to $21.75
Cast borings	6.50 to 7.00
Steel turnings	6.50 to 7.00
Railroad cast	16.00 to 17.00
No. 1 machinery cast	17.75 to 18.25
Burnt scrap	10.00 to 10.50
Iron axles	32.75 to 33.25
Locomotive tires (smooth inside)	27.00 to 27.50
Pipes and flues	13.50 to 14.00
Malleable cast	15.00 to 15.50
Railroad tank and sheet	12.00 to 12.50

Birmingham

BIRMINGHAM, ALA., Jan. 1, 1917.

Coke.—A small amount of standard foundry coke was shipped by express to an Eastern foundry to eke out supplies. It cost $12 per net ton f.o.b. oven. Very little spot foundry coke is changing hands under $10.50 and $11. It is a condition without a precedent. Furnace coke is almost non-existent in the open market, and probably brings as much as $4.50 when obtainable.

Pig Iron.—The most uneventful week in Southern pig-iron circles was the last one of the year, as it was marked by little trading, little inquiry and little effort

in any direction. The latter part of the week an Eastern melter inquired for 1200 tons for second quarter and a leading maker quoted $25. A small lot of white iron, the lowest grade, brought $23. The lowest price recorded for spot iron was $24, which is still named by the largest foundry-iron producer and one other, while others quote $25 for the entire year. The one exception to this attitude is the leading interest, which, while it charges $25 for spot, still quotes $21 and $22 for the last half. However, it has no basic and, it is believed, very little foundry iron to offer. Furnaces are not working regularly on account of the difficulty of obtaining a steady supply of coke. The Republic Iron & Steel Company, which for some time was furnishing other iron makers with coke, is now saving its entire output for its new furnace operations. Warrant iron offered at $22 and $23 has not affected the market, because, after deducting brokers' charges, interest, yardage, etc., it figures back to as much as furnace metal without certainty as to analysis. The freight congestion worries makers, but iron manages to move in greater volume than the output. We quote, per gross ton, f.o.b. Birmingham district furnaces, as follows:

No. 1 foundry and soft	$24.50 to $25.50
No. 2 foundry and soft	24.00 to 25.00
No. 3 foundry	23.50 to 24.50
No. 4 foundry	23.25 to 24.25
Gray forge	23.00 to 24.00
Basic	24.50 to 25.50
Charcoal	25.00 to 26.00

Cast-Iron Pipe.—Pipe makers report a fairly respectable influx of fill-in orders at the advanced prices, but no contracts of any size are offering. We quote, per net ton, f.o.b. makers' yards, as follows: 4-in., $39; 6-in. and upward, $36, with $1 added for gas pipe and special lengths. The American Cast Iron Pipe Company is receiving hot metal direct from furnaces of the Republic Company to its pits at North Birmingham. Experiments so far are reported satisfactory.

Old Material.—The scrap market has softened during the week. There seems no special reason, other than a natural recession from the extremely high levels recently reached. Yards are busy filling the heavy volume of orders booked by them. We quote, per gross ton, f.o.b. dealers' yards, as follows:

Old steel axles	$34.00 to $36.00
Old steel rails	18.00 to 19.00
No. 1 wrought	18.50 to 19.00
No. 1 steel	16.00 to 17.00
No. 1 machinery	16.00 to 17.00
Carwheels	16.00 to 17.00
Tram carwheels	15.00 to 16.00
Stove plate and light	12.50 to 13.00

St. Louis

ST. LOUIS, MO., Jan. 2, 1917.

Pig Iron.—The largest inquiry of the week was for 900 tons of No. 2 Southern foundry for 1917 delivery. Evidence has appeared that brokers are putting forth feelers at shaded prices, if some of the buyers are to be believed. The outstanding feature is the fact that steel-making pig-iron sales, as nearly as can be ascertained, were fully 100 per cent ahead of any previous year in the history of the market.

Finished Iron and Steel.—Consumers continued to urge shipments on all classes of material. A Southwestern road bought 6000 tons of rails and 10 miles of 75-lb. material were sold to another road. Movement out of warehouse was active, and the prices were marked up still further, being quoted to-day, for material out of stock, as follows: Soft steel bars, 3.80c.; iron bars, 3.75c.; structural material, 3.90c.; tank plates, 4.55c.; No. 10 blue annealed sheets, 4.70c.; No. 28 black sheets, cold-rolled, one pass, 5.15c.; No. 28 galvanized sheets, black sheet gage, 7.25c.

Coke.—The nervous situation continues, with abnormal prices paid. By-product coke is out of the market.

Old Material.—Scrap was rather quiet. Dealers, however, are confident of another and stiffer development shortly after the first of the year. Light rails were advanced in the week. Foundry grades of scrap showed the most inquiry. We quote dealers' prices, f.o.b. customers' works, St. Louis industrial district, as follows:

Per Gross Ton

Old iron rails	$27.00 to $27.50
Old steel rails, re-rolling	27.50 to 28.00
Old steel rails, less than 3 ft	27.00 to 27.50
Relaying rails, standard section, subject to inspection	33.00 to 34.00
Old carwheels	20.50 to 21.00
No. 1 railroad heavy melting steel scrap	22.00 to 22.50
Heavy shoveling steel	19.00 to 19.50
Ordinary shoveling steel	17.50 to 18.00
Frogs, switches and guards cut apart	22.00 to 22.50
Ordinary bundled sheet scrap	13.50 to 14.00

Per Net Ton

Iron angle bars	$26.00 to $26.50
Steel angle bars	22.00 to 22.50
Iron car axles	36.50 to 37.00
Steel car axles	37.50 to 38.00
Wrought arch bars and transoms	27.50 to 28.00
No. 1 railroad wrought	22.50 to 23.00
No. 2 railroad wrought	21.50 to 22.00
Railroad springs	23.50 to 24.00
Steel couplers and knuckles	24.00 to 24.50
Locomotive tires, 42 in. and over, smooth inside	26.00 to 26.50
No. 1 dealers' forge	18.00 to 18.50
Cast iron borings	9.00 to 9.50
No. 1 busheling	16.50 to 17.00
No. 1 boilers, cut to sheets and rings	13.00 to 13.50
No. 1 railroad cast scrap	15.00 to 15.50
Stove plate and light cast scrap	10.50 to 11.00
Railroad malleable	16.50 to 17.00
Agricultural malleable	14.00 to 14.50
Pipes and flues	14.00 to 14.50
Heavy railroad sheet and tank scrap	14.50 to 15.00
Railroad grate bars	12.00 to 12.50
Machine shop turnings	9.50 to 10.00
Heavy axle and tire turnings	12.50 to 13.00

New York

NEW YORK, Jan. 3, 1917.

Pig Iron.—It has been a very quiet week so far as domestic demand is concerned. Export inquiries keep up particularly for Italy. At the same time ocean freights have advanced again, $36 from New York to Genoa having been offered, while higher rates are paid from Southern ports. The pig iron for which neutral countries in western Europe have been asking has not yet been bought. A sale of 1000 tons of Bessemer was made by an Eastern furnace at $38.50, Baltimore, for early shipment. Some low phosphorus iron has been sold for export, including 2000 tons for Japan. Scattering lots of pipe iron have been sold but the pipe companies are generally well covered. Several foundries have been in the market for spot coke and are paying $11 to $11.50 at oven. On contract foundry coke $7 to $7.50 a ton is the range of quotations. A number of Eastern furnaces have been compelled to bank several days at a time because coke cannot be had. Among new embargoes are several applying to Virginia points on the Chesapeake & Ohio. Southern warrants are inactive, consumers holding off almost entirely. Here and there speculative interests have been offering warrants at $22 and some are available at $21. We quote at tidewater for early delivery: No. 1 foundry, $30 to $31; No. 2X, $29.50 to $30.50; No. 2 plain, $28.50 to $29.50; Southern iron at tidewater, $29 to $30 for No. 1 and $28 to $29 for No. 2 foundry and No. 2 soft.

Ferroalloys.—An Eastern steel company has purchased 5000 tons of ferromanganese for delivery in the early months of the year. A Canadian interest is in the market for 2000 tons of 80 per cent ferromanganese and 1000 tons of spiegeleisen, for second and third quarters. Quotations for standard ferromanganese are unchanged at $164, seaboard, forward delivery. Most of the importers have none to offer this side of the second quarter. Domestic is unchanged at $175. any delivery, but not so much is available for early shipment, while it happens that most of the demand is for prompt. Inquiry is extensive for 50 per cent ferrosilicon, but it is scarce. The quotation for 50 per cent material is $100 on carloads and $99 on 100 tons or more, these being contract prices. Bessemer ferrosilicon is quoted at $48, furnace, for 11 per cent, $51 for 12 per cent, $54 for 13 per cent, and $57 for 14 per cent. Spiegeleisen is scarce and firm at $60 to $65, furnace, for 19 to 21 per cent.

Finished Iron and Steel.—Railroad traffic difficulties with shortage of cars and resulting scarcity of fuel are portentous through the checking of shipments and cur-

tailment of production. No car relief is in sight in that additional railroad cars and locomotives are not likely to be available before the end of winter. The structural market is dull for the moment with 3.50c., Pittsburgh, however, the best price for very prompt shipments, and 3.25c., Pittsburgh, for large lots in a few months. In bars, mention may be made of an inquiry from the Italian State railroads for 10,000 tons of squares and rounds, wanted as soon as possible. There seems to be no limit placed on the amount of shell steel wanted by France and England, as well as Italy, no tonnage figures being mentioned owing to the difficulty of getting any mill engagements. Track bolts and spikes for several hundred miles of road for France have finally been settled. It is doubtful if more than 3000 cars are regarded as likely purchases by the car builders, but in addition to the long delayed Russian purchases, it now appears that perhaps as many as 10,000 cars will be bought by France. The latest domestic sales cover 2000 cars for the Baltimore & Ohio, placed half with the Pullman Company and the remainder with the Standard Steel Car Company. We quote mill shipments of shapes in two to five months at 3.419c. to 3.669c., New York; at convenience of the mill 3.269c. New York, and warehouse shipments at a minimum of 3.95c., New York. We quote universal and ordinary tank plates at 4.169c. to 5.169c., New York, but Lloyd specification plates at 5.169c. to 6.169c., with little available before the third quarter of 1917 and for plates in the fourth quarter of 1917 and the first quarter of 1918 at 3.769c., New York. Out of store we quote 4.75c., New York, for plates under 36 in. in width and 5c. on wider plates. We quote mill shipments of steel bars at 3.169c. to 3.669c., New York, the lower price for indefinite delivery and the higher for small quantities in, say, three months. We quote mill shipments of bar iron at 3.169c., New York. Out of warehouse iron bars are 3.50c. and steel bars 3.85c., New York.

Cast-Iron Pipe.—All bids were rejected on 2500 tons for the city of Boston, opened Dec. 26. The letting has been re-advertised and new bids will be opened Jan. 9 on the same specifications. No new municipal business of importance has come out. Inquiries from private buyers are running in somewhat greater volume than usual for the season. Prices are firmly maintained at $41.50 per net ton, tidewater, for carload lots of 6 in., class B and heavier, with class A and gas pipe taking an extra of $1 per ton.

Old Material.—The market has not awakened from its holiday stagnation. Dealers are completely at sea as to values in the absence of actual negotiations with buyers. Brokers quote buying prices nominally as follows to local dealers and consumers, per gross ton, New York:

Heavy melting steel scrap (for eastern Pennsylvania shipment)	$20.00 to $20.50
Old steel rails (short lengths) or equivalent	21.00 to 21.50
Relaying rails	37.00 to 38.00
Rerolling rails	27.50 to 28.00
Iron and steel car axles (for export)	45.00 to 47.00
No. 1 railroad wrought	25.00 to 26.00
Wrought-iron track scrap	22.00 to 22.50
No. 1 yard wrought, long	22.00 to 22.50
Light iron (nominal)	6.50 to 7.00
Cast borings (clean)	11.00 to 11.50
Machine shop turnings	9.50 to 10.00
Mixed borings and turnings	7.00 to 7.50
Wrought pipe (not galvanized or enameled)	16.50 to 17.00

Foundries are showing almost as little interest in the market as steel works and rolling mills. Dealers' quotations to consumers of cast scrap are nominally as follows, per gross ton, New York:

No. 1 cast	$22.00 to $22.50
No. 2 cast	19.00 to 19.50
Stove plate	15.50 to 16.00
Locomotive grate bars	15.50 to 16.00
Old carwheels	21.50 to 22.00
Malleable cast (railroad)	18.00 to 18.50

The Champion Iron Works Company, Kenton, Ohio, has secured an order from the Lima Locomotive Corporation, Lima, Ohio, for the crane requirements at its plant and an order from the Winton Engine Company, Cleveland, for one 15-ton crane.

British Steel Market

Italy's High Bids for Billets and Wire Rods—Ferrosilicon Very Firm—Pig Iron Quiet

LONDON, ENGLAND, Jan. 3, 1917.—(*By Cable.*)

The Cleveland pig-iron market is quiet, with export licenses hardly obtainable. Hematite pig iron is easier. Ferrosilicon, 50 per cent, is quoted at £29 10s., and is very firm. American billets are nominal. For forward shipment, c.i.f., £25 upward is asked for wire rods. Italy has bid $116 for 4-in. billets and $136 for wire rods, c.i.f., Genoa, for third quarter delivery.

Benzol is quoted at 15d. and toluol at 2s. 4d. per gal., with ammonium sulphate at £18 15s. We quote as follows:

Tin plates, coke, 14 x 20, 112 sheets, 108 lb., f.o.b. Wales, 34s. 6d.
Steel black sheets, No. 28, export, f.o.b. Liverpool, £19 5s.
Hematite pig iron, f.o.b. Tees, 142s. 6d.
Sheet bars (Welsh) delivered at works in Swansea Valley, £15 5s. nominal.
Ferromanganese, £36 upward.
Ferrosilicon, 50 per cent, c.i.f., £29 10s. against £30 last week.

Iron and Industrial Stocks

NEW YORK, Jan. 2, 1917.

The past week has been broken by holidays, and the volume of business on the stock exchanges has been light, while values have not shown much disposition to change either way. The range of prices on active iron and industrial stocks from Wednesday of last week to Tuesday of this week, inclusive, was as follows:

Allis-Chal., com.	26 - 29⅛	Int. Harv. of N. J., com.	121 -123
Allis-Chal., pref.	84½ - 89	Int. Harv. Corp., com.	83 - 86
Am. Can, com.	45⅝ - 49	La Belle Iron, com.	77½ - 78½
Am. Can, pref.	108½	Lacka. Steel	80½ - 87
Am. Car & Fdy., com.	63½ - 67⅝	Lake Sup. Corp.	18¾ - 20¼
Am. Car & Fdy., pref.	116½-117	Midvale Steel	57 - 62⅝
Am. Loco., com.	75½ - 80¾	Nat. En. & Stm., com.	26½ - 29½
Am. Loco., pref.	105¼-105½	Nat. En. & Stm., pref.	91
Am. Ship, com.	64 - 66⅝	N. Y. Air Brake	142 -150
Am. Ship, pref.	96⅞ - 97	Nova Scotia Stl.	110½-125
Am. Steel Fdries.	60 - 63½	Pitts. Steel, pref.	101½-102
Bald. Loco., com.	55⅝ - 61⅝	Pressed Stl., com.	72⅛ - 78
Bald. Loco., pref.	100½-102	Pressed Stl., pref.	105
Beth. Steel, com.	500 -525	Ry. Steel Spring, com.	49 - 51
Beth. Steel, pref.	135 -137	Ry. Steel Spring, pref.	99
Cambria Steel	110 -125	Republic, com.	75⅝ - 80
Central Fdry., com.	24 - 25	Republic, pref.	103½-105⅝
Central Fdry., pref.	40½	Sloss, com.	60 - 66½
Chic. Pneu. Tool	66 - 71½	Un. Alloy Steel	48 - 50½
Colo. Fuel	43¾ - 46⅞	U. S. Pipe, com.	21 - 22½
Cruc. Steel, com.	59⅝ - 65½	U. S. Pipe, pref.	60
Cruc. Steel, pref.	113½-115½	U. S. Steel, com.	103⅝-110⅝
Deere & Co., pref.	98½ - 98⅞	U. S. Steel, pref.	119½-120
Driggs-Seabury	45½ - 49½	Va. I. C. & Coke	50
Gen. Electric	165¾-169¾	Warwick	9⅝
Gt. No. Ore Cert.	34¾ - 37½	Westing. Elec.	54½ - 56¾
Gulf States Steel	121 -133		
Gulf. S. Steel, 1st pref.	107		

Dividends

The New Jersey Zinc Company, regular quarterly, 4 per cent, and extra 10 per cent, payable Jan. 10.

The Chicago Pneumatic Tool Company, regular quarterly, 1 per cent, payable Jan. 15.

The Charcoal Iron Company of America, 2 per cent on account of back dividends on the preferred stock, payable Feb. 28, leaving only 2 per cent to be provided for.

The American Shipbuilding Company, regular quarterly, 1¾ per cent on the preferred stock, payable Jan. 15.

The Eastern Steel Company, entire accumulated dividends on the second preferred stock, payable Dec. 30.

The Hupp Motor Car Corporation, regular quarterly, 1¾ per cent on the preferred stock, payable Jan. 2.

The Nova Scotia Steel & Coal Company, regular quarterly, 2 per cent on the preferred stock, payable Jan. 15.

The Otis Elevator Company, regular quarterly, 1¼ per cent on the common and 1½ per cent on the preferred stock, payable Jan. 15.

The Saxon Motor Car Corporation, 1¾ per cent, payable Jan. 17.

The Standard Steel Tube Company, Toledo, Ohio, at its recent annual banquet for employees, distributed life insurance policies as holiday gifts. The employees at the conclusion of the dinner presented President George B. Storer a silver service, etc., and Superintendent Charles Shmull a gold watch.

Finished Iron and Steel f.o.b. Pittsburgh

Freight rates from Pittsburgh in carloads, per 100 lb.: New York, 16.9c.; Philadelphia, 15.9c.; Boston, 18.9c.; Buffalo, 11.6c.; Cleveland, 10.5c.; Cincinnati, 15.8c.; Indianapolis, 17.9c.; Chicago, 18.9c.; St. Louis, 23.6c.; Kansas City, 43.6c.; Omaha, 43.6c.; St. Paul, 32.9c.; Denver, 68.6c.; New Orleans, 30.7c.; Birmingham, Ala., 45c. Denver, pipe, 76.1c., minimum carload, 46,000 lb; structural steel and steel bars, 83.6c., minimum carload, 36,000 lb. Pacific coast (by rail only), pipe, 65c.; structural steel and steel bars, 75c., minimum carload, 50,000 lb.; structural steel and steel bars, 80c., minimum carload, 40,000 lb. No freight rates are being published via the Panama Canal, as the boats are being used in transatlantic trade.

Structural Material.—I-beams, 3 to 15 in.; channels, 3 to 15 in.; angles, 3 to 6 in. on one or both legs, ¼ in. thick and over, and zees 3 in. and over, 3c. to 3.25c. Extras on other shapes and sizes are as follows:

	Cents per lb.
I-beams over 15 in.	.10
H-beams over 18 in.	.10
Angles over 6 in., on one or both legs	.10
Angles, 3 in., on one or both legs less than ¼ in. thick, as per steel bar card, Sept. 1, 1909	.70
Tees, structural sizes (except elevator, handrail, car truck and conductor rail)	.05
Channels and tees, under 3 in. wide, as per steel bar card, Sept. 1, 1909	.20 to .80
Deck beams and bulb angles	.30
Handrail tees	.75
Cutting to lengths, under 3 ft. to 2 ft. inclusive	.25
Cutting to lengths, under 2 ft. to 1 ft., inclusive	.50
Cutting to lengths, under 1 ft.	1.55

No charge for cutting to lengths 3 ft. and over.

Plates.—Tank plates, ¼ in. thick, 6 in. up to 100 in. wide, 3.60c. to 5c., base, net cash, 30 days, or ½ of 1 per cent discount in 10 days, carload lots. Extras are:

Quality Extras

	Cents per lb.
Tank steel	Base
Pressing steel (not flange steel for boilers)	.10
Boiler and flange steel plates	.15
"A. B. M. A." and ordinary firebox steel plates	.20
Still bottom steel	.30
Locomotive firebox steel	.50

Marine steel, special extras and prices on application.

Gage Extras

Rectangular, ¼ in. thick, over 6 in. wide to 100 in. wide	Base
Lighter than ¼ in. to 3/16 in. up to 72 in. wide	.10
*Lighter than ¼ in., including 3/16 in., over 72 in. to 84	.20
*Lighter than ¼ in., including 3/16 in., over 84 in. to 96	.30
*Lighter than ¼ in., including 3/16 in., over 96 in. to 100	.40
*Lighter than ¼ in., including 3/16 in., over 100 in. to 102	.45
Lighter than 3/16 in., including No. 8, up to 72 in. wide	.15
*Lighter than 3/16 in., including No. 8, over 72 in. to 84	.25
*Lighter than 3/16 in., including No. 8, over 84 in. to 96	.35
Lighter than No. 8, including No. 10, up to 60 in. wide	.30
Lighter than No. 8, including No. 10, over 60 in. to 64	.35

Up to 72 in. and not less than 10.2 lb. per sq. ft. will be considered ¼ in.

Over 72 in. must be ordered ¼ in. thick on edge, or not less than 11 lb. per sq. ft. to take base price.

Over 72 in. wide, ordered less than 11 lb. per sq. ft., down to weight of 3/16 in., take price of 3/16 in.

Over 72 in., ordered weight 3/16 in., take No. 8 price.

Over 72 in., ordered weight No. 8, take No. 10 price.

Width Extras

Over 100 in. to 110 in. inclusive	.05
Over 110 in. to 115 in. inclusive	.10
Over 115 in. to 120 in. inclusive	.15
Over 120 in. to 125 in. inclusive	.25
Over 125 in. to 130 in. inclusive	.50
Over 130 in.	1.00

Length Extras

Universal plates 80 ft. long up to 90 ft. long	.05
Universal plates 90 ft. long up to 100 ft. long	.10
Universal plates 100 ft. long up to 110 ft. long	.20

Cutting Extras

No charge for rectangular plates to lengths 3 ft. and over.

Lengths under 3 ft. to 2 ft. inclusive	.25
Lengths under 2 ft. to 1 ft. inclusive	.50
Lengths under 1 ft.	1.55
Circles 3 ft. in diameter to 100 in.	.30
Circles over 100 to 110 in. (width extra)	.35
Circles over 110 to 115 in. (width extra)	.40
Circles over 115 to 120 in. (width extra)	.45
Circles over 120 to 125 in. (width extra)	.55
Circles over 125 to 130 in. (width extra)	.80
Circles over 130 in. (width extra)	1.30
Circles under 3 ft., to 2 ft., inclusive	.55
Circles under 2 ft., to 1 ft., inclusive	.80
Circles under 1 ft.	1.85

Half circles take circle extras.

Sketches not over four straight cuts, inc. straight taper	.10
Sketches having more than four straight cuts	.20

Plates sheared to a radius take complete circle extras.

*Including extra for width.

Wire Rods.—Including chain rods, $70 to $75.

Wire Products.—Prices to jobbers effective Nov. 27: Fence wire Nos. 6 to 9, per 100 lb., terms 60 days or 2 per cent discount in 10 days, carload lots, annealed, $2.95; galvanized, $3.65. Galvanized barb wire and staples, $3.85; painted, $3.15. Wire nails, $3. Galvanized nails, 1 in. and longer, $2 advance over base price; shorter than 1 in., $2.50 advance over base price. Cement-coated nails, $2.90. Woven wire fencing, 53 per cent off list for carloads, 52 off for 1000-rod lots, 51 off for less than 1000-rod lots.

Wrought Pipe.—The following are the jobbers' carload discounts on the Pittsburgh basing card in effect from Dec. 29, 1916, all full weight:

Butt Weld

Steel			Iron		
Inches	Black	Galv.	Inches	Black	Galv.
⅛, ¼ and ⅜	57	30½	⅛ and ¼	46	19
½	61	46½	⅜	47	20
¾ to 3	64	50½	½	51	33
			¾ to 1½	54	40

Lap Weld

2	57	44½	1¼	40	25
2½ to 6	60	47½	1½	46	32
7 to 12	57	43½	2	47	33
13 and 14	47½	..	2½ to 4	49	36
15	45	..	4½ to 6	49	36
			7 to 12	48	35

Reamed and Drifted

1 to 3, butt	62	48½	¾ to 1½, butt	49	32
2, lap	55	42½	1¼, lap	35	19
2½ to 6, lap	58	45½	1½, lap	41	26
			2, lap	42	27
			2½ to 4, lap	45	30

Butt Weld, extra strong, plain ends

⅛, ¼ and ⅜	53	35½	⅛, ¼ and ⅜	46	29
½	58	45½	½	51	38
¾ to 1½	62	49½	¾ to 1½	55	40
2 to 3	63	50½			

Lap Weld, extra strong, plain ends

2	55	43½	1¼	42	27
2½ to 4	58	46½	1½	47	33
4½ to 6	57	45½	2	49	36
7 to 8	53	39½	2½ to 4	51	39
9 to 12	48	34½	4½ to 6	50	38
			7 to 8	44	32
			9 to 12	39	27

To the large jobbing trade an additional 5 per cent is allowed over the above discounts, which are subject to the usual variation in weight of 5 per cent. Prices for less than carloads are two (2) points lower basing (higher price) than the above discounts on black and three (3) points on galvanized, but in some sections of the country discounts on less than carloads are three (3) points less (higher price) than the carload discount on both black and galvanized steel pipe.

On butt and lap weld sizes of black iron pipe, discounts for less than carload lots to jobbers are four (4) points lower (higher price) than carload lots, and on butt and lap weld galvanized iron pipe are five (5) points lower (higher price).

Boiler Tubes.—Discounts on less than carloads, freight to be added, effective from Nov. 1, 1916, except 3 to 4½ in. steel from Nov. 20, are as follows:

Lap Welded Steel		*Standard Charcoal Iron*	
1½ in.	31	1½ in.	23
1¾ and 2 in.	43	1¾ and 2 in.	35
2¼ in.	40	2¼ in.	32
2½ and 2¾ in.	46	2½ and 2¾ in.	38
3 and 3¼ in.	46	3 and 3¼ in.	43
3½ to 4½ in.	46	3½ to 4½ in.	44
5 and 6 in.	45	5 and 6 in.	37
7 to 13 in.	42	7 to 13 in.	34

Locomotive and steamship special charcoal grades bring higher prices.

1¾ in., over 18 ft., and not exceeding 22 ft., 10 per cent net extra.

2 in. and larger, over 22 ft., 10 per cent net extra.

Sheets.—Makers' prices for mill shipments on sheets of United States standard gage, in carload and larger lots, are as follows, 30 days net, or 2 per cent discount in 10 days:

Blue Annealed Sheets

	Cents per lb.
Nos. 3 to 8	4.00 to 4.25
Nos. 9 to 12	3.75 to 4.00
Nos. 13 to 16	3.85 to 4.10

No. 17 and lighter gages are based on $4.50 per 100 lb. for No. 28 Bessemer black sheets.

Box Annealed Sheets, Cold Rolled

Nos. 17 to 21	4.30 to 4.55
Nos. 22 and 24	4.35 to 4.45
Nos. 25 and 26	4.40 to 4.65
No. 27	4.45 to 4.70
No. 28	4.50 to 4.75
No. 29	4.55 to 4.80
No. 30	4.65 to 4.90

Galvanized Sheets of Black Sheet Gage

Nos. 10 and 11	5.25 to 5.75
Nos. 12 to 14	5.35 to 5.85
Nos. 15 and 16	5.50 to 6.00
Nos. 17 to 21	5.65 to 6.15
Nos. 22 and 24	5.80 to 6.30
Nos. 25 and 26	5.95 to 6.45
No. 27	6.00 to 6.50
No. 28	6.25 to 6.75
No. 29	6.40 to 6.90
No. 30	6.55 to 7.05

Tin Mill Black Plate

Nos. 15 and 16	4.05 to 4.20
Nos. 17 to 21	4.10 to 4.25
Nos. 22 to 24	4.15 to 4.30
Nos. 25 to 27	4.20 to 4.35
No. 28	4.25 to 4.40
No. 29	4.30 to 4.45
No. 30	4.30 to 4.45
Nos. 30½ and 31	4.35 to 4.50

Metal Markets

The Week's Prices

Cents Per Pound for Early Delivery

Dec.	Copper, New York Lake	Copper, New York Electrolytic	Tin, New York	Lead New York	Lead St. Louis	Spelter New York	Spelter St. Louis
27	30.00	30.00	40.25	7.45	7.30	9.75	9.50
28	30.00	30.00	40.75	7.50	7.35	9.75	9.50
29	29.50	29.50	41.50	7.50	7.35	9.75	9.50
30	29.50	29.50	.....	7.50	7.35	9.75	9.50
Jan. 2	29.50	29.50	43.00	7.50	7.35	9.75	9.50

NEW YORK, Jan. 2, 1917.

The attitude of the copper producers is unchanged, but resellers of the metal, including some consumers, have been offering it at substantial concessions. Except on one or two days, tin has been quiet, but quotations are stronger at both New York and London. A quiet, drifting market sums up the lead situation. Spelter has moved slowly at prices that showed but little or no variation. Business in antimony is quiet, but quotations are higher.

New York

Copper.—The producers are merely watching the market, but they can afford to do so in view of their sold-up condition. The week has been quiet, the only activity being that which has resulted from offerings at concessions by resellers, among whom are not a few consumers. Under the pressure to sell, the prices have declined, and there is more metal offered than appears to be wanted. Prompt electrolytic and Lake were quoted yesterday at 29.50c., and even less might have been accepted had a firm offer been made. The situation is not accounted altogether a comfortable one for the producers, for should too great a decline ensue they might not be able to deliver some of the metal they sold at well over 30c. Large size brass rods, much used in munitions work, are easier at about 33c., mill, but ordinary brass and copper products are unchanged.

Copper Averages.—The average price of Lake copper for the month of December, based on daily prices in THE IRON AGE, was 32.94c., and for electrolytic, 32.94c.

Tin.—The market appeared quiet on Dec. 27, but nevertheless a good business was done, between 300 and 400 tons changing hands, all for far future delivery. The appearance of quiet resulted from the selling having been confined to two houses. On Dec. 28 and 29 about 200 tons was taken, also forward deliveries, with the same sellers again figuring. Otherwise the market has been quiet, except that on Dec. 29 a sale of 100 tons was made under the rule on the New York Metal Exchange, just why does not appear, although it is believed that a contract was in dispute. For 50 tons of March, 40.62½c. was paid, and for 50 tons of April, 40.70. The deliveries into consumption in December totaled 4082 tons.

Lead.—Only moderate sales have been made in the past week, although more might have been done had more chemical lead been available. Prices have been steady in a drifting market, but the trade is confident that activity will develop early this year. Both the leading interest and independent producers continue to quote 7.50c., New York, although the former is not selling except on the basis of average quotations. The St. Louis quotation yesterday was 7.35c.

Spelter.—The demand has been slow and draggy, but prices in the past week have changed but little. For prompt shipment, quotations are around 9.75c., New York; for first quarter, 9.50c., and for the first half, 9.25c., with St. Louis about ¼c. lower on all positions. There are plenty of sellers. Producers' stocks are said to have decreased of late, but there is no telling how much spelter is in second hands. It is admitted that the course of prices depends on the export demand, and this showed a falling off in December.

Antimony.—The market is dull, but holders have marked up their prices, and are asking for 14.50c. to 15c. for Asiatic grades.

Aluminum.—The quotation for No. 1 virgin metal, 98 to 99 per cent pure, is unchanged at 60c. to 63c.

Old Metals.—The demand has fallen off and the market is weaker. Dealers' selling prices are as follows:

	Cents per lb.
Copper, heavy and crucible	29.00 to 30.00
Copper, heavy and wire	28.00 to 29.00
Copper, light and bottoms	24.00 to 25.00
Brass, heavy	17.50 to 18.00
Brass, light	15.00
Heavy machine composition	23.00 to 24.00
No. 1 yellow rod brass turnings	17.50 to 18.50
No. 1 red brass or composition turnings	17.00 to 19.00
Lead, heavy	7.00
Lead, tea	6.50
Zinc	7.00 to 7.50

Chicago

JAN. 2.—The metal market has been generally quiet but firm, with few changes from last quotations. We quote: Casting copper, 29.75c.; Lake copper, 31.75c.; tin, carloads, 42.50c., and small lots, 44.50c.; lead, 7.50c.; spelter, 10c.; sheet zinc, 21c.; Cookson's antimony, 50c.; other grades, 17c. On old metals we quote buying prices for less than carload lots as follows: Copper wire, crucible shapes, 25c.; copper bottoms, 22.50c.; copper clips, 25c.; red brass, 22c.; yellow brass, 17c.; lead pipe, 5.75c.; zinc, 6c.; pewter, No. 1, 26c.; tinfoil, 32c.; block tin pipe, 36c.

St. Louis

JAN. 2—The market has been quiet. Lead, carload lots, is quoted at 7.50c.; spelter, 9.75c. In less than carloads, quotations are: Lead, 7.75c.; spelter, 11c.; tin, 46c.; Lake copper, 32c.; electrolytic copper, 31.50c.; antimony, Asiatic, 16c. In the Joplin ore district weakness still prevailed, smelters keeping out of the market to a considerable extent. On miscellaneous scrap metals, dealers' buying prices are as follows: Light brass, 10.50c.; heavy yellow brass, 14c.; heavy red brass and light copper, 19c.; heavy copper and copper wire, 22c.; zinc, 6c.; lead, 5c.; tea lead, 4.50c.; pewter, 25c.; tinfoil, 34c.

To Prevent Cancellations in Purchases of Range Boilers

A form of contract designed in part to prevent speculative buying by jobbers—in short one whose stipulations are to be met to the letter—has been issued by the manufacturers of range boilers and expansion tanks through what is known as the Range Boiler Exchange, Whitehall Building, New York. It is stipulated in acknowledging an order that no cancellations or changes in specifications or changes in shipping instructions will be accepted for any reason, and that the goods will be billed at the prices specified and shipment will be made at the option of the manufacturer, "dependent upon business conditions." A resolution passed by the manufacturers, copies of which have been sent to the Federal Trade Commission, provides that orders must be accompanied by full and complete specifications and that the order acceptance and duplicate shall be signed by the manufacturer and customer and be considered as a contract.

American interests are reported to have incorporated recently the North American Antimony Smelting Company, Ltd., of Canada, with a capitalization of $2,000,000. An option on the antimony mines at Lake George in the U. S. Consular district of St. Stephen, New Brunswick, has been secured.

Tungsten exports from Bolivia in the first quarter of 1916 were 1,211,730 lb., of which 75 per cent went to the United States and 25 per cent to Europe. It is reported that considerable ore is being purchased and stored until the close of the war.

The National Malleable Castings Company has placed an order for 11 cranes of 10 and 15 tons capacity for its new Cleveland plant with the Pawling & Harnischfeger Company, Milwaukee.

Machinery Trade's Continued Prosperity

Awakening of Domestic Demand Made 1916 More Satisfactory Than 1915—Prices Are 46 Per Cent Higher Than Two Years Ago

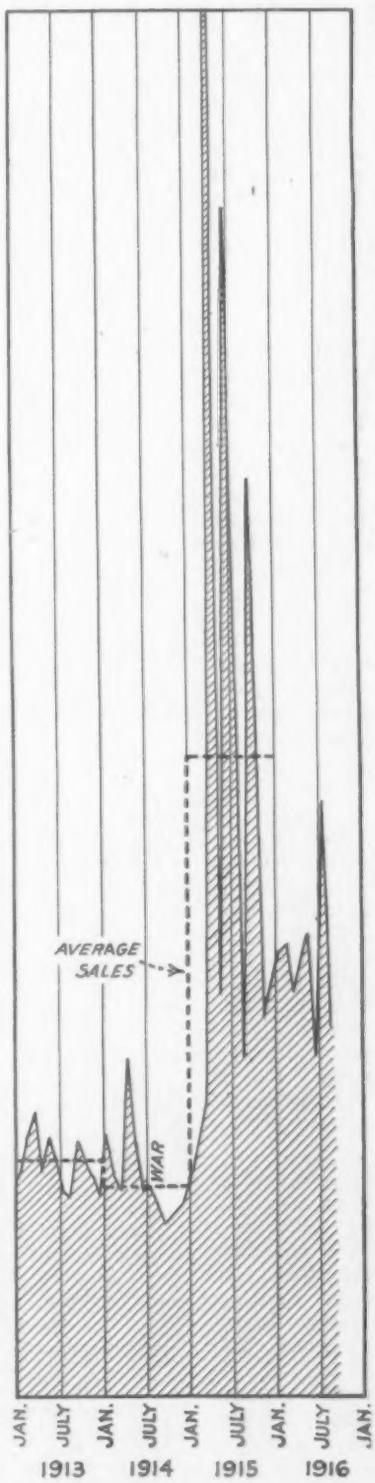
In 1915 the wonderful volume of demand which came to the machine-tool trade was based principally on the requirements of the makers of munitions, whereas that of 1916 came chiefly from domestic industrial sources. The year, therefore, is considered as compared with 1915, to have been more satisfactory. In 1916 the majority of buyers were those on whom dependence must be placed in the future. They showed a discrimination in choosing equipment, and evidenced a willingness to wait a reasonable time to obtain deliveries of good standard tools, which were lacking in war buyers.

While many in the industry considered that 1915 was the most prosperous year in history, others point out that prosperity did not reach its height in that year, for the reason that shipments, rather than orders, mean money, and shipments were not at their greatest until 1916 had been entered. With many manufacturers export deliveries were heavier in 1916 than in 1915, especially in the first six months. The receipts of manufacturers and dealers were greatly increased in 1916 by the higher prices which prevailed. The dealers in 1915 profited greatly from the great quantity of second-hand machinery, for which they found eager buyers at high prices.

Average Price Advance 46 Per Cent

A compilation of the prices of a number of standard machine tools, embracing certain lathes, milling, planing, drilling, grinding and shaping machines, etc., enables a determination to be made of the average price advances in the two years. The lowest rate of advance for an individual machine in a group of 64 tools, including not only different kinds of machines, but various sizes, is 17 per cent, which applies to a grinding machine. The highest is 78 per cent for a lathe with a selective head, although 71 per cent applies to certain radial drills, planers and lathes. The rate for the entire list of 64 tools is approximately 46 per cent. Since October there have been further advances in some lines, some having been announced as late as December.

The per cent of increase in the years 1914-1916, indicated by the prices of 16 standard milling machines made by one builder, is 41.



How the volume of business done by a dealer in machine tools mounted to unprecedented heights following the outbreak of the war. Both export and domestic business is represented in the war period. Dotted line indicates yearly average of sales

With one make of turret lathes and screw machines the prices of 4 items indicate that the average advance was 44 per cent.

With one make of planing machines the prices of 4 items indicate that the average advance was 63 per cent.

With one make of radial drills the prices of 5 items indicate that the average advance was 64½ per cent.

With one make of drilling machines the prices of 4 items indicate that the average advance was 41 per cent.

With one make of lathes the prices of 6 items indicate that the average advance was 70 per cent.

One company's price for a vertical surface grinder showed an advance of 33 per cent.

With one make of shaping and gear cutting machine the prices of 10 items showed an average advance of 47½ per cent.

With one make of grinding machines the prices of 3 items showed an average advance of 33 per cent.

With another make of grinding machines the prices of 4 items showed an average advance of 21½ per cent.

With one make of broaching machines the prices of 2 items showed an average advance of 20 per cent.

With one make of drilling machines the prices of 2 items showed an average advance of 18 per cent.

With one make of vertical turret lathes the prices of 3 items showed an average advance of approximately 42 per cent.

The railroads were not heavy buyers at any one time in the year, although all of them bought for replacement as necessary, and a few good-sized lists were issued. There are indications that they will be more active in 1917. The shipyards and steel mills did more buying than in many years. Throughout the past 12 months backward deliveries retarded business, this being especially true in the first few months. Not only were the tool builders oversold, but they were hampered by distressing strikes that spread over practically all sections of the country where tools are manufactured. With it all came transportation troubles.

War Buyers Wanted Big Lathes

In March it was seen that the war business was on the wane, single-

purpose lathes, in particular, being in lighter demand. However, large lathes then became active, and again in July they were wanted in great number for the manufacture of 6 to 12 in. shells. In fact, it may be said that the heaviest war demand of the year was for big lathes, needed for large shell work, the heavier projectiles having superseded shrapnel and the smaller high-explosive shells.

A quiet period came in August and September, but from Oct. 1 the rush of industrial plants to replace and enlarge their equipment created a boom, which still exists. The automobile and motor accessory makers were large buyers, this being true of those in the East as well as of these in the West. Government buying was rather light, although notable additions to the arsenals are expected at Frankford, Pa., in particular. Considerable equipment for the Watervliet Arsenal was purchased a few weeks ago.

Tool Builders Bought Heavily

The machine-tool builders, both old-established and new, were themselves heavy buyers of machine tools, a fact which is set forth in an article elsewhere in this issue of THE IRON AGE, dealing with the development of the metal-working machinery industry. It has been estimated that in the past two years probably 100 companies, new to the field, undertook the manufacture of machine tools of one kind or another. A few of these have retired from the business, but others have remained as competitors of the older manufacturers, and are even trying to extend their lines and output. A large wood-working machinery company has discontinued the manufacture of lathes, but these machines are still being made by a crane builder. A steam pump company made lathes for its own use, then continued making them for the market. A firm specializing in tobacco-working machinery has made turret lathes because it could not get deliveries from a manufacturer. There are but a few examples, whose number could be multiplied many times.

The great demand for turret lathes, more particularly screw machines, has caused a number of companies to turn to their manufacture, and in some cases complaint has been bitter over the extent to which the designs of well-known machines have been copied.

For the past two years fear has been aroused from time to time as to the injury which the trade might suffer from the throwing on the market of large quantities of used tools for which munitions makers no longer had use. It is gratifying to note that up to the present very little harm has come from this source. Some such tools have been offered, but a good many of them were found to be unsalable from the hard usage to which they had been subjected, as well as because of their being short of attachments and essential parts. Conservative members of the trade continue to look, however, for considerable dumping of these machines in the future.

November is figured by some tool interests to have been the best month of 1916, not only because of the volume of business, but because of the diversity of tools wanted by expanding domestic industry. A large manufacturer states that February ranked next to November, then September. In the latter part of the year many sellers found the export demand lighter, but a good business on foreign account was still being done. Early in the year it was extremely good. The export business shows a tendency to become centralized in the hands of the several big export houses which have come into being since the beginning of the war and a few which already were in existence. Just what interests are going to represent the bulk of American tool builders in Europe after the war is still an undetermined question, despite the strenuous efforts that have been made by various interests to obtain exclusive agency arrangements.

A development of the year was the action of Russia, following the example of Great Britain, in imposing strict regulations governing the importation of tools in that country. It became necessary to give the Russian consular authorities complete data concerning shipments, including the name of the ultimate consignee, etc. Of late Russian buyers have been arranging principally for deliveries next spring and summer.

A large machine-tool company, in comparing its business of November, 1915, with that of November, 1916, stated that in the latter year its business was 20 per cent for export and 80 per cent for domestic delivery, whereas in November, 1915, its export business amounted to 70 per cent and its domestic to 30 per cent of the total, indicating an almost complete reversal of conditions.

OLD YEAR ACTIVE TO END

Canada Maintains Output of Munitions

Took More Machine Tools Than in Any Previous Year—Extensive Improvements Planned for Arsenal at Watertown, Mass.

Considering the interruption interposed by the holidays, business has been exceptionally good. More would have been done had it not been for a desire on the part of many buyers to have their purchases recorded under a 1917 date line. An interesting development noted in New York is that the funds of some manufacturers are so nearly tied up by extensive operations that they have asked for easier terms of payment for tools which they need.

Heavy machines have been in good demand in Cleveland. The railroads have been doing some small-lot buying in that city.

The United States Government has plans prepared for extensive improvements at the Watertown Arsenal, Watertown, Mass. An addition, estimated to cost $500,000, will be built for manufacturing purposes, and a new projectile shop will cost about $215,000.

Our Cincinnati report points out that more machine tools were shipped to Canada in 1916 than in any previous year. Some of these tools passed to Europe, but the majority remained in Canada for munitions work. In this connection it is interesting to note that Canadian banks have placed an additional $50,000,000, making $250,000,000 in all, at the disposal of the government for the purchase of munitions and supplies. It is expected that munitions orders amounting to over $175,000,000 will be placed in the near future, all of which indicates the continuance of Canada as an unusually active customer in the machine-tool market. Since 1914 about 50 American firms have established branch factories in Canada.

A Milwaukee firm has declined an export order for 60 milling machines because of the pressure from the domestic field.

New York

NEW YORK, Jan. 2, 1917.

Miscellaneous inquiries were numerous in the holiday week. In not a few cases buyers asked that formal orders be deferred until this month for bookkeeping reasons. With some builders of machine tools, December was the best month of the year. The pressure of business under which some users of tools are working is demonstrated by the fact that they have asked, in placing orders, that established terms be departed from and made more lenient, their request being based on the fact that an abnormal amount of their capital is tied up by current operations.

Small groups of lathes have been sold in the week for export to Italy, and boring mills for shipment to France. An inquiry from South Africa calls for a few turret screw machines. A consulting engineer of this city is inquiring for

100 medium sized turret lathes for export to France. The Singer Mfg. Company placed an order for 700 screw machines with an Indiana manufacturer. The machines are for export to England, and presumably for munitions work.

The plant of the Standard Shipbuilding Company, Shooter's Island, New York, was damaged by fire, Dec. 28. Daily newspaper reports placed the loss at $500,000 and said that several buildings, including the power plant, had been destroyed, but the company states that the fire was confined to a plate shed of wooden canstruction.

The representative of a firm in Buenos Aires, Argentina, which manufactures safes, has found it so difficult to buy special bolts, nuts, screws and like parts in this country that he has determined to buy the necessary machinery for making them. It will mean the establishment of a shop where none existed. He says that other South American firms find themselves in the same predicament.

The Himoff Machine Company, 45 Mill Street, Astoria, L. I., N. Y., has increased its capital stock from $20,000 to $100,000 to provide sufficient working capital for the manufacture of a line of gear-hobbing machines and other new machinery which it has recently brought out.

The Smith & Caffrey Company, manufacturer of structural and ornamental steel, gray-iron castings, etc., Syracuse, N. Y., has started the construction of additions which will increase the capacity of its structural steel department 4 or 5 times. The new building will be 90 x 160 ft., and will be erected on a site recently acquired by the company at Lodi and Bear streets, opposite its present buildings, and is to be completed in the spring at an estimated cost of $30,000. The plant at present is employing 200 men, but this force will be materially increased after the addition is ready. Much new machinery will be installed.

The Joline Corporation, 115 Broadway, New York, recently incorporated with a capital stock of $100,000 to manufacture check-writing machines, is now considering leasing a suitable plant and is negotiating for the purchase of machinery. Benjamin F. Joline, Tottenville, Staten Island, N. Y., is president; Alfred E. Finlay, 676 Riverside Drive, New York, vice-president; Ralph C. Morgan, Hotel Willard, New York, secretary and treasurer.

The Kellog Mfg. Company, manufacturer of air pumps and automobile accessories, Rochester, N. Y., plans to double its production this year.

The McClintic-Marshall Company, Pittsburgh, has been awarded contract for the erection of a rolling mill, 70 x 400 ft., one story, for the Atlas Crucible Steel Company, at Dunkirk, N. Y.

The Ferguson Steel & Iron Company, Buffalo, is closing contract for an addition to its fabricating shop at Bailey Avenue and the New York Central Railroad, of steel and brick to cost approximately $200,000.

The Augustine Automatic Rotary Engine Company, 1862 Elmwood Avenue, Buffalo, N. Y., has purchased a site, 66 x 150 ft., and 52 x 170 ft., on the River Road, Bridgeburg, Ont., on which it will build a branch factory.

The Rome Brass & Copper Company, Rome, N. Y., has let contracts for a casting shop, 140 x 220 ft., one-story; and an addition, 60 x 120 ft., one-story, to be made to its refinery building.

The Elmira Foundry Company, Elmira, N. Y., has been incorporated with a capital stock of $300,000. S. G. H. Turner, A. M. Loudon and J. E. McCann, Elmira, are the incorporators. Contract has been let for a foundry building, 150 x 160 ft., one-story, to be erected at Main Street and Woodlawn Avenue, at a cost of $25,000.

The By-Products Company, 10 Broadway, New York City, will build a new boiler house addition to its plant on Shooter's Island, near Staten Island, New York, to cost $125,000. A new tankage plant to cost $150,000 will also be erected.

Fire Dec. 28 damaged the plate shop and boiler factory at the plant of the Standard Shipbuilding Corporation, 44 Whitehall Street, New York, on Shooter's Island, in Newark Bay, with loss reported at $50,000.

Reuther Brothers, Harrison, N. J., operating a foundry for gray-iron castings, have acquired property on Essex Street, near Sixth Street, and will build a new foundry, to be completed this spring. The present foundry has been purchased by the Hyatt Roller Bearing Company.

The Air Reduction Company, Jersey City, N. J., manufacturer of oxygen, will build a new reinforced-concrete plant at 177-87 Pacific Avenue to cost $60,000.

The Allen Valve Mfg. Company, Jersey City, N. J., has been incorporated with a capital stock of $75,000, to manufacture valves. John H. Allen, W. F. Madill and G. Perry Haynes are the incorporators.

Joseph T. Ryerson & Son, Jersey City, N. J., have filed plans for a one-story addition to their iron and steel warehouse on West Side Avenue to cost $12,000.

New England

BOSTON, MASS., Jan. 1, 1917.

The United States Government has had plans prepared for an addition to the manufacturing buildings at the Watertown Arsenal, Watertown, Mass., to cost about $500,000; for a projectile machine shop to cost $215,000; for repairs and equipment of a smith shop to cost $52,600; and for improvements to the power plant.

The James Russell Boiler Works Company, Boston, Mass., has begun the erection of a building, 110 x 147 ft., one story.

The Laundry Machine Company, Willimantic, Conn., which is now located in part of the plant of the Vanderman Mfg. Company, is arranging to build a factory, 80 x 150 ft., two stories, on Wilson Street.

The Hartford Special Machinery Company, Hartford, Conn., has purchased a lot of land adjoining its present site, to permit of future expansion.

The plant of the L. H. Goodnow Foundry Company, Fitchburg, Mass., was damaged to the extent of about $5,000 by a fire, Dec. 25, which burned off the roof.

The Continental Wood Screw Company, New Bedford, Mass., is planning to build a new factory, 40 x 260 ft., two stories.

In order to facilitate its further exxpansion, the W. & S. Mfg. Company, manufacturer of metal stampings, 9 Hunt Street, Worcester, Mass., has incorporated under the name of the Worcester Stamped Metal Company, with a capital stock of $150,000. In the past it has specialized in stamped parts for automobiles and motor cycles, as well as stamped specialties of all kinds. The new company will add to its equipment and go into still heavier work, although much of the work done in the past would be classed as heavy stampings. During the past few years it has devoted its attention to building up a general stamping business rather than to fit up for munition work. The business has been in continuance since 1883, but the present equipment is entirely up-to-date and adapted for a wide range of work.

The Bridgeport Steel Company, Bridgeport, Conn., has begun the erection of a hammer shop, 54 x 118 ft., one story, on Stratford Avenue.

The New York, New Haven & Hartford Railroad has announced that it will make a main distribution point for freight for a considerable part of its system at Woodmont, a station in Milford, Conn. There will be an extensive yard established at this point and among the buildings to be erected will be a repair shop.

The G. & O. Mfg. Company, New Haven, Conn., manufacturer of motor truck radiators, has increased its capital to $100,000.

The Ramsdell Specialty Company, Worcester, Mass., has awarded a contract for an addition, 50 x 70 ft.

The Baldwin Chain & Mfg. Company, Worcester, Mass., has awarded a contract for a factory, 81 x 95 ft., two stories, to be erected on Hygeia Street.

The American Steel & Wire Company, Worcester, Mass., is building an addition, 33 x 68 ft., one story, at its North Works.

The Hood Rubber Company, Watertown, Mass., has secured a permit for the erection of a foundry and pattern shop, 80 x 160 ft., two stories, on Melendy Avenue.

The Austin Company, Cleveland, Ohio, and Bridgeport, Conn., has been awarded contract by the Stamford Rolling Mills Company, Stamford, Conn., for the erection of a two-story smelter building, 72 x 200 ft.

The Wright Wire Company, Worcester, Mass., has awarded a contract for a factory building at its Worcester plant, 64 x 230 ft., two stories, to be equipped with a 2-ton electric traveling crane. The company will also build a boiler house and a connecting corridor, 15 x 45 ft., one story and basement, between two of its present buildings.

The National Mfg. Company, Bridgeport, Conn., maker of metal novelties, has been incorporated for $25,000 and will begin business with $10,000. The incorporators are Andrew Tucker, Louis J. Auger and Stephen Toth, of Bridgeport, and William Miller, Charles McLean and Joseph Miller, Stratford.

The Stamford Rolling Mills Company, Stamford, Conn., is erecting at its Fairfield Avenue plant an addition to its rolling mill, 38 x 300 ft., one story, and a boiler house.

P. E. Somers, tack and nail manufacturer, 35 Lagrange Street, Worcester, has sold his business to the Diamond Tack & Nail Works, Boston. It has been reported that Mr. Somers has been offered the position of general superintendent of the Diamond Tack & Nail Works, but has not definitely accepted the position.

The Adams Coal Mining Machinery Company, New London, Conn., has been incorporated for $10,000 by Henry Adams, Nathan Belcher, William Belcher and W. H. Belden.

Philadelphia

PHILADELPHIA, PA., Jan. 2, 1917.

The Hamburg Boiler Works, Hamburg, Pa., manufacturer of boilers and tanks, and operating a machine repair shop, will build an addition to its plant, about 250 ft. long; a new engine and boiler house will be included. It is in the market for a good second-hand belt-driven angle bending roll of 4 x 4 x ½-in. capacity, and later on will require a set of belt-driven plate bending rolls 10 ft. 2 in. wide to work a ½-in. plate, top roll raised and lowered with power; also a 4-ft. drill press for drilling or cutting tube holes. Henry Seiders is proprietor.

The Hale & Kilburn Company, 1600 Lehigh Avenue, Philadelphia, manufacturer of shapes and other iron and steel specialties, has awarded contract for the erection of an eight-story brick and reinforced-concrete addition, 120 x 235 ft., at Sixth and Filbert streets, to cost $450,000. Cramp & Co., Philadelphia, are the contractors.

James H. Wiley, South Bethlehem, Pa., operating a plant for the manufacture of toy cannons and similar specialties, has acquired a four-story factory at Prospect Avenue and Conestoga Street, Bethlehem, as a site for a new plant. The present South Bethlehem plant will be moved to the location, which will give employment to about 250 persons.

The James H. Billington Company, 113 Chestnut Street, Philadelphia, manufacturer of mill supplies, has acquired property, 36 x 190 ft., with a five-story factory building, adjoining its present plant on North Randolph Street, to be used as an extension.

The Delph Spinning Company, Clearfield Street, Philadelphia, will build a new boiler plant, 35 x 50 ft., on Third Street to cost $5,000.

The General Scientific Equipment Company, maker of scientific instruments, hydrometers, thermometers, etc., 2719 West Lehigh Avenue, Philadelphia, has been incorporated in Delaware with a capital stock of $75,000 by Alfred J. Zimmerman, Maurice Kline and A. J. Leonard, and has plans in preparation for a three-story factory, 110 x 124 ft., of brick and stone, to provide adequate manufacturing facilities. Maurice Kline is general manager.

William Birmingham & Co., Philadelphia, manufacturer of leather products, will build a new three-story addition, 24 x 85 ft., at 4058 Haverford Avenue.

The Weimer Chain & Iron Company, Lebanon, Pa., is having plans prepared for an addition to its plant, 40 x 200 ft., on Eighth Avenue and the Pennsylvania Railroad.

Beryl H. Kendrick, Philadelphia, has organized a company for the establishment of a plant for the manufacture of aeroplanes. A site has been acquired at Atlantic City, N. J., providing 10,000 sq. ft. of floor space for initial operations. Blaine Elkin is also active in the company.

Chicago

CHICAGO, ILL., Jan. 2, 1917.

The Chicago Malleable Castings Company, 120th Street and South Racine Avenue, Chicago, advises that its new construction will provide enlarged facilities for its wood and metal pattern departments and a machine shop for general repair work. This latter building will be 60 x 125 ft., and the equipment for it will be purchased shortly.

The Hurley Washing Machine Company has purchased property in Taylor Street, between Campbell and Rockwell streets, Chicago, on which it will erect a three-story factory with a floor area of 240,000 sq. ft. and a daily capacity of 3000 machines.

E. R. Klemm, 1453 Austin Avenue, Chicago, will build a two-story brick factory at 1447 Austin Avenue to cost $20,000.

The Chapell Ice Cream Company, 2500 Fullerton Avenue, Chicago, will erect an ice-cream factory at 190 Webster Avenue at a cost of $60,000. F. R. Schock is the architect.

The Chicago Hardware Foundry Company, North Chicago, Ill., will build an addition to its plant, 38 x 108 ft., to cost approximately $7,000. It will be used for office purposes.

The plant of the Davis-Ewing Concrete Company, Bloomington, Ill., was damaged by fire, the loss to building and machinery being about $10,000.

The Lincoln Electric Works will open a plant at Macomb, Ill., and expects to be in operation by Jan. 15.

The H. Koppers Company, St. Paul, Minn., will make the following additions to its plant: Brick coke ovens, 31 x 225 ft., to cost $210,400; a brick and steel manufacturing building, 63 x 204 ft., to cost $40,300 and a smokestack built of reinforced concrete, to cost $7,800.

The Ajax Frog & Switch Company, Blue Island, Ill., will erect a plant at Superior, Wis., to cost $100,000.

W. S. Dodge, manager of the Grinnell Washing Machine Company, Grinnell, Iowa, has organized a company which will be known as the Dodge Tool Company and will operate a plant at Grinnell shortly after the first of the year.

Indianapolis

INDIANAPOLIS, IND., Jan. 2, 1917.

The Peerless Foundry Company, Indianapolis, Ind., is erecting buildings at 1853 to 1935 Ludlow Avenue, as follows: A three-story warehouse, 102 ft. square; a two-story machine shop and pattern room, 62 x 80 ft., and a foundry, 70 x 100 ft.; to cost about $50,000 in building and new machinery and to be ready for occupancy about April 1, 1917. The company will increase its capital stock to $100,000. It manufactures furnaces, laundry stoves, stove and furnace repairs, hot plates and also jobs in stove sundries. The officers of the company are William G. Williams, president. Turly J. Cornwell, vice-president and manager, and Harry Fox, secretary and treasurer.

The Montpelier Mfg. Company, Fort Wayne, Ind., expects to install additional machinery in its plant within a short time.

The Bass Foundry & Machine Company, Fort Wayne, Ind., has plans for the construction of a new factory building.

Milwaukee

MILWAUKEE, WIS., Jan. 2, 1917.

A local machine-tool builder has just declined to accept an order for 60 milling machines in three sizes for export because the insistent demand of domestic purchasers and the oversold condition of shops preclude delivery before late in next fall. The demand upon tool builders is so heavy that it is extremely difficult to handle all the domestic business proffered. This consists principally of single tools or small lots, and buyers are glad to have delivery even four, five and six months hence. Production has suffered to some extent by the almost paralyzed condition of railroad transportation. Numerous metal-working plants have been obliged to reduce working schedules temporarily, or close down entirely because of the shortage of fuel, non-delivery of materials, or inability to move finished goods already in cars and standing on sidetracks.

The Kempsmith Mfg. Company, Milwaukee, maker of milling machines, has taken an order for 20 milling machines from the Aksai Machinery Company, Russia, which recently has placed extensive orders for tools with Middle Western tool builders. The order specifies delivery at seaboard between April 1 and June 30.

The plant of the National Concrete Machinery Company, 211 South Paterson Street, Madison, Wis., was damaged by fire Dec. 20 with a loss of about $10,000. It is planned to erect a fireproof factory in the spring. S. T. Walker is president.

The Milwaukee & Fox River Valley Electric Railway Company has engaged Jerry Donohue, consulting engineer, Sheboygan, Wis., to survey for a proposed hydroelectric plant on Mullett River, near Sheboygan. George Brickbauer, Plymouth, is president.

The Walker Mfg. Company, Racine, Wis., manufacturer of automobile parts and tools, has commenced the installation of equipment in its new plant, and expects to begin operations before Jan. 15.

The Schram Mfg. Company, Ladysmith, Wis., manufacturer of hardwood products, is contemplating the installation of new wood-working machinery.

A. H. Gray, Tomah, Wis., is having plans made for a garage and repair shop, 45 x 100 ft.

The Lasure Friction Clutch Pulley Company, Charles City, Iowa, is moving its works and headquarters to Madison, Wis., and is re-establishing itself at 619 Williamson Street. It was organized in July by Iowa and Madison capital to take over a company at Charles City manufacturing a clutch unit for gasoline engines. The daily capacity of the Madison plant is 50 units, but production will be increased as rapidly as equipment can be obtained. The officers are: President, Kem E. Penney; vice-president and treasurer, Ralph L. Richardson; secretary, B. M. Parsons.

The W. A. Walker Mfg. Company, Racine, Wis., manufacturer of automobile jacks, accessories and parts, resumed operation in its new plant at North Michigan and Hamilton streets, Jan. 2, which provides 36,000 sq. ft. of floor space and cost $50,000. The company is increasing its force of 100 men to 150. W. A. Walker is president; M. H. Walker vice-president, Willard T. Walker, secretary and treasurer.

The American Safety Signal Company, Milwaukee, has been incorporated with a capital stock of $10,000 by H. M. Momerow, Charles Manel and Nels Nelson.

Cleveland

CLEVELAND, OHIO, Jan. 2, 1917.

The demand for machine tools is very good for the holiday season. The call at present is largely for heavy tools and inquiries are for most part limited to one or two machines. Deliveries on lathes have become better and milling machines are not as hard to find for early shipment as they have been recently. The Loomis-Seilaff Company, which will establish a plant in Cleveland, has purchased about $50,000 worth of machinery the past few weeks. Railroads in this section are buying some machine tools in small lots. In addition to its large list of machine tools, the Great Northern Railroad is in the market for about 100 motors, ranging from 5 to 500-hp. The demand from industrial plants for cranes continues very active.

The Shields Machine Company, Cleveland, has established a plant in the Whitney Power Block to do general machine work. S. S. Shields heads the company.

The National Tool Company, Cleveland, maker of milling cutters and other tools, has taken out new incorporation papers providing for a capital stock of $1,800,000.

The McLaren Iron Works, Cleveland, has completed plans for a new factory, 60 x 200 ft., one and two stories, and an office building.

The Steubenville Steel Tie Company, Steubenville, Ohio, recently organized, is formulating plans for a plant to manfacture steel ties. L. L. Grimes is president and Nate Sutton, secretary.

The American Malleable Castings Company, Marion, Ohio, will enlarge its foundry by the erection of two extensions, 61 x 185 ft., and 44 x 58 ft., respectively.

It is reported that the Gilliam Mfg. Company, Canton, Ohio, will erect three buildings, 110 x 200 ft., 30 x 230 ft., and 60 x 80 ft., respectively, for use as gray and malleable iron foundries.

The Portage Iron & Wire Company, Akron, Ohio, recently incorporated with a capital stock of $50,000, has acquired a site in East Akron on which it plans shortly to erect a plant for the manufacture of stair work, fire escapes, fences and ornamental iron work, and will specialize in iron work for use in rubber factories. J. A. Backman is president, E. E. Vogelbeer, vice-president and general manager, and J. A. Wohlgenant, secretary and treasurer.

The Brown Motor Company, Moline, Ill., has been incorporated with a capital of $20,000 by Walter E. Brown, James E. Johnston, Louis E. Stanton, Henry H. Hutton, G. L. Boston and Paul A. Biggs. The company will operate manufacturing plants.

Detroit

DETROIT, MICH., Jan. 1, 1917.

The machinery trade suffered a pronounced falling off the past week, due to the holidays. The market was extremely quiet, with no large orders placed and few small ones. Keen interest is manifest in the future and jobbers predict a record year. Manufacturers are promising the enlargement of their business and many changes. Deliveries remain as they were, standard machines requiring from 3 to 6 months.

The W. J. Baird Machinery Company, 54 Jefferson Avenue, Detroit, is enlarging its facilities. At present the company is handling wood and iron-working machinery, factory supplies, and installs machine-shop systems.

The Climax Shock Absorber Company, Benton Harbor, Mich., has been organized to manufacture shock absorbers and other automobile accessories. The stockholders are William A. Vawter, St. Joseph, Mich.; William A. Vawter, Jr., and John Steiner, Benton Harbor.

The McAdamite-Aluminum Company, Detroit, has been organized by John P. Caritte, Sr., John P. Caritte, Jr., and Mack Ryan to manufacture metals.

The Yankee Auto Specialty Company, Detroit, has been incorporated at $50,000 to manufacture automobiles and parts. The principal stockholders are George W. Bolton and William S. Bolton, Highland Park, Mich., and Melbourne Walker, Detroit.

The H. W. Selle Company, Manistique, Mich., proposes to erect a plant to manufacture excelsior. It will cost $35,000.

The Flying Dutchman Aerial Company, incorporated for $30,000, is planning to locate a plant in Muskegon, Mich., to make a new type of super-aeroplane. The company has been formed by John and S. L. Buchanan, Holland, Mich., and William L. Baudette, Chicago.

The Universal Valveless Four Cycle Motor Company, through Charles E. Johnson, president and general manager, has purchased 3 acres of land in Muskegon, Mich., and will begin the erection of a plant in the spring.

The Western Motor Appliance Company, Charles City, Iowa, will locate in Alma, Mich. The erection of two new buildings will be in operation by April 1. The Western Motor Appliance Company makes a specialty of a kerosene carburetor.

The Fritz Mfg. Company, Grand Rapids, Mich., has sold only its drafting-room furniture line to the Hamilton Mfg. Company of Two Rivers, Wis., not its entire business nor any of its machinery, as was incorrectly stated in THE IRON AGE of Dec. 21.

The Oliver Instrument Company, Detroit, Mich., manufacturer of machine tools, will build a factory at Adrian, Mich., and move its plant there.

The Kawneer Mfg. Company, Niles, Mich., has let the contract for an all-steel two-story addition to its plant, 60 x 470 ft.

The Montgomery-Ward Company of Chicago has taken over the Field-Brundage Company's plant at Jackson, Mich., for the manufacture of gasoline engines. It will install considerable new machinery and increase the size of the factory.

Fire did about $2,000 worth of damage at the plant of the Grand Rapids Foundry Company, Grand Rapids, Mich.

The Fuller & Sons Mfg. Company, builder of automobile parts, Kalamazoo, Mich., is purchasing some machinery for its new plant.

Cincinnati

CINCINNATI, OHIO, Jan. 2, 1916.

While definite statements are not yet available, it is generally known that more machine tools were shipped to Canada in 1916 than in any previous year. Some of this machinery went to Europe, but a large part is installed in Canadian shops making war munitions. Many lathes shipped in 1915 were single-purpose machines for shell work, but later quite a number of standard sized tools were ordered. Domestic firms, engaged in munitions manufacture, also switched to standard sized tools when they were obtainable, but buying from this source has slackened considerably in the past six months. At present automobile and auto-truck makers are the best customers, and the demand from this source is expected to keep up well into this year. Indications are also evident that the railroads will be heavy buyers in 1917. It can be conservatively stated that this year's prospects are very bright for the machine tool trade. Should the export demand be shut off, manufacturers believe that domestic orders will take up the slack in a very short time after the period of readjustment that may ensue with the cessation of hostilities in Europe.

The G. A. Schacht Motor Truck Company, Cincinnati, has increased its capital stock from $25,000 to $100,000 and is adding equipment to its plant in West End.

The plant of the LeMontree Mfg. Company, Cincinnati, manufacturer of wire goods and metal specialties, was almost completely destroyed by fire Dec. 24. Rebuilding plans have not yet been given out.

The Webster & Perks Tool Company, Springfield, Ohio, has leased half of the first floor of the Shuey Factories Building, which will be fitted up to manufacture machine tools. It now occupies the entire top floor and part of the third floor of the Shuey Building, but found its quarters inadequate to take care of its expanding business.

The National Mortar Supply Company, Springfield, Ohio, will make further additions to its plant at Cold Springs, and will install 10 new kilns, and other special equipment.

The J. C. Callery Engineering Company, Columbus, Ohio, has been incorporated with $25,000 capital stock to market a new smoke consumer. J. C. Callery, Ohio State boiler inspector, is one of the incorporators.

The Quick Work Company, St. Marys, Ohio, has been incorporated with $400,000 capital stock to manufacture special sheet metal working machinery. O. E. Dunan and Hobart Scott are among the incorporators.

The Central South

LOUISVILLE, KY., Jan. 2, 1917.

The beginning of the year finds the local steel and machinery trades in good condition. In some lines there is a seasonable inactivity as to sales, although these same lines are in the market for supplies in preparation for what they expect will be a busy spring. Embargoes in effect are not preventing shipments out of Louisville. Another coal shortage is threatened and coal prices are advancing.

The H. H. Poutch Company, Louisville, Ky., has been incorporated with $31,000 of capital stock by H. H. Poutch and others to engage in lumber and mill work.

The Murphy Chair Company, Detroit, Mich., has completed

negotiations for purchase of the Stenotype Company plant at Owensboro, Ky., and will establish a factory, having been given a bonus in the form of free power and free water for three years. The Detroit plant will gradually be removed to Owensboro.

Fire destroyed the electric power plant, sawmill and other departments of the Tennessee Lumber & Veneer Company, Johnson City, Tenn., at a loss of more than $100,000.

Birmingham

BIRMINGHAM, ALA., Jan. 2, 1917.

The demand for coal mine equipment has become an extensive one for the first time in two years. This is owing to numbers of new collieries being opened. All iron-working apparatus is active. Dealers report short holiday takings and an almost immediate resumption of activities.

The Roper Straus Ferst Tile Company, Birmingham, has increased its capital stock from $30,000 to $45,000.

The Bush-Mosely Company, Fox, Ala., has been organized by J. Q. Bush, W. T. Mosely and others of Tuscaloosa, Ala., with a capital stock of $10,000, to establish a wood-working plant.

The Louisville & Nashville Railroad will expend $200,000 in dock improvements at Mobile, including the rebuilding of the coal hoist, banana conveyers, etc. W. H. Courtenay, Louisville, is chief engineer.

The city of Atlanta contemplates the expenditure of $200,000 for new pumps, filtration basin, etc., at its waterworks plant.

The Tampa Shipbuilding & Engineering Company, Tampa, Fla., has been incorporated with a capital stock of $800,000 by Ernest Kreher, Peter O. Knight and others, and has acquired the plant of the Tampa Machine & Foundry Company. It proposes to extend the plant and build steel ships.

Texas

AUSTIN, TEX., Dec. 30, 1916.

The year 1916 has been a very satisfactory one to the machinery and tool trade of Texas and the Southwest. Unusual activity has been shown in establishing new manufacturing industries. This is particularly true as to cotton-seed oil mills, compresses and gins. Prospects are believed to be favorable for a continuation of the present trade conditions through the year 1917.

The Alliance Mill Co., of Denton, will install new machinery in its flour mill and build a brick storage room at a total cost of $75,000. The company plans to construct an eight unit concrete fireproof elevator of a total capacity of 200,000 bushels later in the year.

The crate and box manufacturing plant of the Graham Mfg. Company, Longview, recently destroyed by fire, will be rebuilt at a cost of about $40,000.

The Emerson Motors Company, 47 West Thirty-fourth Street, New York, will build an assembling plant at Fort Worth to cost about $100,000.

Edward S. Brodix of Brownsville and associates, including a syndicate of Chicago men, have taken preliminary steps toward building harbor work and port facilities near the mouth of the Rio Grande about 25 miles below Brownsville. Government aid of the project will be requested.

An army motor truck garage and repair shop will be built at Brownsville. The Government, through the quartermaster's department at Fort Sam Houston, has leased two blocks of ground upon which the garage and shops will be erected. The building will be 160 x 320 ft.

St. Louis

ST. LOUIS, MO., Jan. 2, 1917.

A short week did not make for much actual closing of new business in the machine tool market. Dealers reported no indications of a cessation in buying. The buying is general in character. Manufacturing operations are continuing under full head and extension and replacement buying is very steady.

The Efficiency Machine Works Corporation, St. Louis, Mo., has been incorporated with a capital stock of $14,000 by D. D. Molloy, Paul Carey and E. F. Cameron and is in the market for equipment.

The Singer Auto Traffic Signal Company, St. Louis, Mo., incorporated in Delaware, has been authorized to use its $200,000 of capital in manufacturing operations in St. Louis. F. W. A. Vesper, St. Louis, is president. An electric mechanical traffic signal for motor cars will be manufactured.

The Macon Motor Car Company, Macon. Mo, has been incorporated with a preliminary capital stock of $2,000 by S. J. Joyce, H. B. Clarkson and Charles J. Kentz and will take over the assets and plant of the All Steel Motor Car Company of Macon as soon as proper legal proceedings can be had.

The Federal Motor Truck Company will build and equip a branch assembling plant and machine shop at Little Rock, Ark.

Ponca City, Okla., will install an additional 200-kw. generating unit. Philip R. Dunton is superintendent.

The Iowa Pipe Line Company, Muskogee, Okla., has been incorporated with a capital stock of $100,000 by A. S. Nelson, L. C. Schlapkohl and G. W. Fry and will equip a pipe line into Iowa, including heavy pumping machinery.

The Pyramid Refining Company, Oklahoma City, Okla., has been incorporated with a capital stock of $100,000 by Abner Davis, W. H. Sadler and others and will equip an oil refinery.

The Columbia Cooperage Company, McGehee, Ark., will equip a cooperage plant at Vicksburg, Miss., and will require wood-working machinery.

Woodville, Miss., Charles Cohen, clerk, will receive bids for a water works plant and an electric light plant, including one 75-hp. semi-Diesel oil engine, centrifugal two-stage pump, 250 gal. per min. capacity, one belt-driven air compressor.

The Seidel Furniture Mfg. Company, New Orleans, La., will replace its plant destroyed by fire recently. About $30,000 worth of wood-working machinery will be required.

The Peavy-Wilson Lumber Company, Leesville, La., will equip a mill near that city with a daily capacity of 150,000 ft. of lumber. It will also equip a lumber railroad and buy engines, etc.

DeRidder, La., C. C. Davis, mayor, will equip a pumping plant of about 1,000,000 gal. per day capacity and will expend about $30,000 on machinery.

The Forschler Motor Truck Mfg. Company, New Orleans, La., has plans for the erection of a motor truck manufacturing plant.

California

LOS ANGELES, CAL., Dec. 27, 1916.

The machine shop to be erected by the Baker Iron Works, North Broadway, Los Angeles, will be increased to about 100 x 300 ft., fronting 100 ft., on North Broadway. Two electric traveling cranes of 5 and 25 ton capacity respectively, will be installed. Exclusive of machinery and equipment the structure will cost about $50,000.

The Central Pacific Improvement Corporation, 1910 South Main Street, Los Angeles, will build an addition to its machine shop at 1918-22 South Main Street to cost about $2,000.

Cyril E. Brayton, Los Angeles, has organized the Brayton Mfg. & Chemical Company to establish a plant near Long Beach for the manufacture of high explosives, at a cost of about $150,000. A site has been selected west of the plant of the California Glass Insulator Works, near the main line of the Southern Pacific Railroad.

The Spreckels Sugar Company, San Francisco, is reported to be planning the erection of a sugar factory at Manteca, in the San Joaquin district, to cost about $2,000,000.

The Pacific Northwest

SEATTLE, WASH., Dec. 23, 1916.

At no time within the past two years have the iron and steel works, foundries and machine shops of the Pacific Northwest done such a volume of work as that now on hand. The increased activity in the shipping industry, the revival in the lumber business, with the consequent additions to mill and logging machinery, and the reawakening of other industrial lines, have contributed to the splendid condition now prevailing. Practically all the larger foundries have been forced to expand their facilities. Orders for rush delivery and spring delivery have caused several plants in Tacoma, where improvements and extensions were made only last summer, to arrange for further enlargements after Jan. 1. The enormous activity in shipbuilding has caused shipbuilders to place big orders for equipment close by. The result has been an extremely heavy business in power winches, engines and heavy repair work. Lumbermen close to the shipbuilding business on Puget Sound and the Columbia River assert that 1917 will bring orders from that source for 100,000,000 ft. and that the railroads of the country will be in the market for 40,000,000 ft. within the next few months. A majority of the mills have called in their sales representatives.

The lumber industry, still hampered by transportation difficulties, is hardly furnishing its normal quota of machinery business, but it is hoped that this condition will improve now that the movement of holiday freight is over. Mining and smelting corporations are constantly in the market, buy-

ing some good-sized lots of machine tools as well as miscellaneous machinery. Implement manufacturers are extremely busy, and there is a large call for agricultural power equipment with both electric and gas motive power. Electrical development is fairly active.

The Anderson Shipbuilding Company, Seattle, has been incorporated with a capital stock of $1,000,000 by J. L. Anderson, E. H. Flick, A. J. Weiffenbach and James Campbell.

The Northern Pacific Railway has placed a contract with the E. J. Rounds Construction Company, Seattle, for the construction of a terminal plant, including a roundhouse, machine and blacksmith shops, tanks, heating system, etc.

The Northwest Marine Construction Company has been organized at Port Townsend, Wash., with a capital of $500,000, by A. McFarland of San Francisco, F. J. Carver and B. M. Pinney of Seattle.

The plant of the Llewellyn Iron Works, Los Angeles, Cal., recently burned out, will be rebuilt as soon as possible.

The Vulcan Mfg. Company, Seattle, has signed contracts for furnishing all the castings for the Skinner & Eddy Shipbuilding Corporation, the Ames Shipbuilding Company and for the first three ships to be constructed by J. F. Duthie & Co. In addition it is building 66 steam winches for local and Grays Harbor shipyards.

The proposed erection of a paint factory to cost $250,000 in Seattle by the Goheen Mfg. Company, Canton, Ohio, A. J. Capron, Portland representative, has resulted in a plan to construct a linseed-oil mill on an adjoining site in that city at a cost of $250,000. Herman Myers of the Carstens Packing Company will have charge of the oil plant construction work. Plans include a dock and a 500-ft. brick building.

The Seattle Construction & Dry Dock Company, Seattle, will construct a two-story punch shed and a mold loft at its shipbuilding plant, 102 x 150 ft., to cost $15,000.

George F. Thorndyke, Seattle, shipbroker, has received instructions from an eastern client to call for bids for six four-masted schooners, each 1000 tons net register, to cost about $1,000,000.

The Everett Packing Company, Everett, Wash., contemplates the erection of a factory to manufacture tin cans. It now owns and operates three large canneries. J. O. Morris, S. P. McGhie and S. Chase, Jr., are the proprietors.

Canada

TORONTO, ONT., Dec. 30, 1916.

A further Imperial Credit of $50,000,000 has been provided by the chartered Banks of Canada. This is the result of a conference which took place recently at Ottawa, Ont., between representative bankers and Sir Thomas White, Minister of Finance for Canada. He has been informed by the Canadian Bankers' Association that the sum of $50,000,000 will be advanced to the Dominion Government, which will place the amount to the credit of the Imperial Government for the purchase of munitions and supplies in Canada. This makes a total of $250,000,000 provided by the banks and the Government jointly in advances to the Imperial Government for the purpose of purchasing shells and munitions. As a result of the establishment of these credits orders to a much greater amount have been obtained for Canada by the Imperial Munitions Board.

It is reported that munitions orders will shortly be placed with Canadian companies manufacturing war munitions amounting to between $175,000,000 and $200,000,000. It is stated that Canada has developed facilities to handle a shell business of $400,000,000 during 1917.

The Northern Bolt, Screw & Wire Company, Ltd., Owen Sound, Ont., has been incorporated with a capital stock of $500,000 by John McEwen, J. M. Kilbourn, president; Clarence L. Vanwyck and others, to manufacture nails, bolts, nuts, taps, dies, wire, etc. It will make additions to its plant and conduct the business on a larger scale. A new keg mill, 50 x 100 ft., will be erected, as well as additions to the main building. A very large share of the company's business at present is export trade. Recently an order was received for 22,000 kegs of nails from the French Government, in addition to large quantities of bolts, etc. The company has also received large contracts from British firms.

The British Cordite Company, Ltd., Montreal, has been incorporated with a capital stock of $50,000 by William R. L. Shanks, Francis G. Bush and others to manufacture explosives, etc.

The St. Louis Auto Machinery Company, Ltd., Windsor, Ont., has been incorporated with a capital stock of $40,000 by Joseph B. St. Louis, Joseph F. Knight, Henry C. Cage and others of Windsor, to manufacture automobiles, machinery, cycles, tools, etc.

The Big 3 Company, Ltd., Winnipeg, Man., has been incorporated with a capital stock of $10,000 by James Caesar, Trygor Haugeraud, Earl S. Everall and others to manufacture oil producers, machinery, etc.

The Dominion Iron & Wrecking Company, Ltd., Montreal, has been incorporated with a capital stock of $50,000 by Frank J. Charman; Isaac C. Gaskell, Lewis H. Cohen and others to manufacture locomotives, machinery, etc.

Francis Hankin & Co., Ltd., Montreal, has been incorporated with a capital stock of $45,000 by Francis Hankin, Charles Champoux, Montreal; Alfred H. Hill, St. Lambert, Quebec, and others, to manufacture steel, machinery, etc.

The Pembroke Machining Company, Ltd., Pembroke, Ont., has been incorporated with a capital stock of $100,000 by Edward A. Dunlop, James F. Munro, Charles A. Eaton and others to build and operate a foundry and machine shop.

The Metal Foundries of Canada, Ltd., Montreal, has been incorporated with a capital stock of $50,000 by John M. Duffy, 157 Bay Street; James G. Hamilton, Marjorie L. Chamberlain and others, all of Toronto.

The Gibbons Motor Car Company, Ltd., Toronto, has been incorporated with a capital stock of $100,000 by Samuel H. Gibbons, 35 Conduit Street; John W. Franks, 491 Palmerston Avenue, and others, to manufacture automobiles, parts, etc.

P. C. Ketchersid, Wichita, Kan., proposes to erect a plant at London, Ont., for the manufacture of brushes, etc., to cost $75,000.

The Toronto Street Railway Company's car barns on King Street East, Toronto, were completely destroyed by fire, with 300 cars. The loss will amount to $750,000.

The Bathurst Lumber Company, Bathurst, N. B., proposes to erect a new paper mill, also to develop 10,000 hp., at Grand Falls, on the Nepisiguit River. Angus McLean is president and general manager.

The Michipicoten Power & Paper Company, Toronto, recently incorporated with a capital stock of $6,500,000, proposes to erect a 150-ton news print mill at Michipicoten Harbor, Ont. It will also erect a 125-ton ground wood plant, spending about $6,000,000 on these plants. Lewis M. Wood, president of the Standard Chemical, Iron & Lumber Company, Royal Bank Building, Toronto, is active in the undertaking.

The Dominion Steel Corporation, Sydney, N. S., proposes to make a number of improvements to its plant. Mark Workman is president.

The Hayes Wheel Company of Canada, Chatham, Ont., will erect an addition to its plant to cost $10,000.

The Dominion Abrasive Wheel Company, Ltd., Mimico, Ont., is erecting a factory at Mimico to cost $75,000.

The Canadian Robert Dollar Company has awarded contract to James McDonald & Co., Standard Bank Building, Vancouver, for the erection of sawmill buildings and a wharf at Vancouver to cost $200,000. New machinery will be required for the mills.

E. & T. Fairbanks & Co., Sherbrooke, Que., will build an addition to its scale plant at a cost of $8,000.

The Acme Tire & Rubber Company, 471 Yonge Street, Toronto, has leased premises at Oakville, Ont., and is in the market for the following new or second-hand machinery: One 150-hp. boiler; one high-pressure and one low-pressure pump; two motors; a mixing machine; a callender machine and vulcanizers.

Amherst, N. S., proposes to purchase a motor-driven centrifugal pump for its waterworks. W. F. Donkin is town clerk.

A. Venator, 222 John Street North, Hamilton, Ont., will have a garage erected to cost $10,000.

The North Bay Toy Company, North Bay, Ont., will build a factory next spring to cost $15,000.

Charles H. Vessot, 67 Balsam Avenue, Ottawa, will shortly erect a machine shop to cost $6,000.

The Port Arthur Copper Company, Ltd., Toronto, recently incorporated, will build a concentrating plant at Port Arthur. F. M. Connell, Traders Bank Building, Toronto, is active in the project.

The Huntley Mfg. Company, Silver Creek, N. Y., manufacturer of canners' machinery, will erect a factory at Tillsonburg, Ont., next spring, to cost $25,000.

Plans are being prepared by F. J. Brule, 603 Royal Bank Building, Toronto, for the nickel refinery to be erected at Wahnapitae, Ont., for the British-American Nickel Corporation.

Government Purchases

WASHINGTON, D. C., Jan. 2, 1917.

Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, until Jan. 16, schedule 567, for three 10-in. engine lathes and three 8-in. precision lathes, all for Brooklyn.

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